

MACHINERY

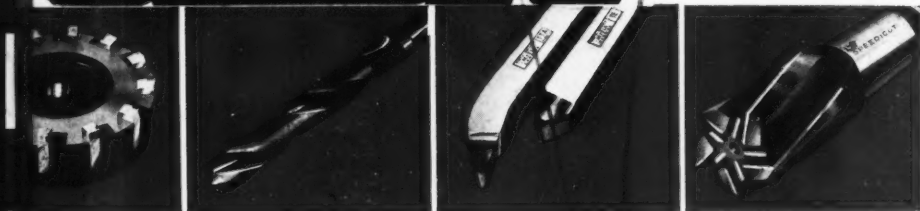
JULY 26, 1961

ONE SHILLING & THREEPENCE



*What's in
your
tooling future...*

**PROBLEMS
or
PROFITS ?**



specify

SPEEDICUT

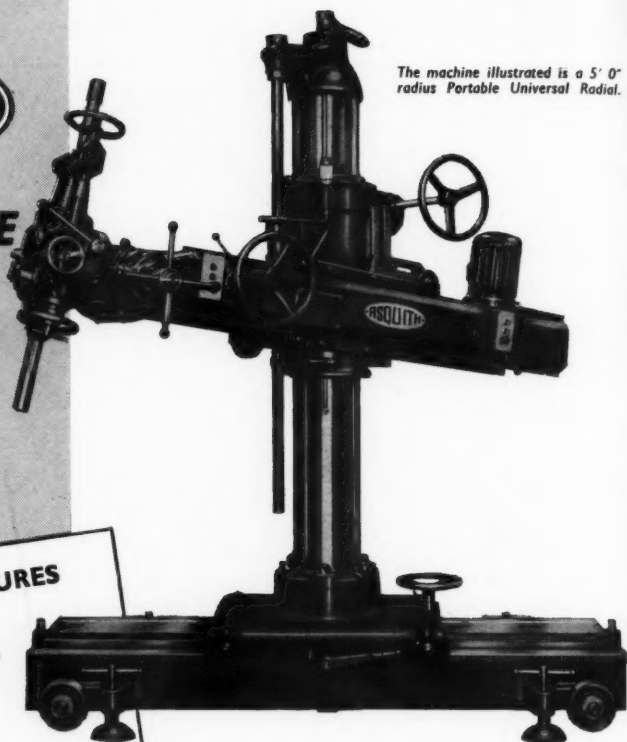
TOOLS

FOR YOUR PRODUCTION

FIRTH BROWN TOOLS LIMITED · SPEEDICUT WORKS · CARLISLE ST. EAST · SHEFFIELD



**The PORTABLE
UNIVERSAL
RADIAL**
of modern
design



The machine illustrated is a 5' 0" radius Portable Universal Radial.

UP-TO-DATE FEATURES

Shaft drive from Motor
(no belts)

Ball bearing rolls to
"in" and "out" traverse of arm

Wide range of feeds and speeds

Quick return after tapping

Power and hand elevating and
lowering to arm

Exceptional ease of control

A robust machine of up-to-date design which ensures trouble free operation. It incorporates a large number of ball journal bearings; special attention has been paid to efficient clamping of the swivelling parts and shaft drive from the motor is a noteworthy modern feature. The arm can be elevated in a dead vertical position to facilitate tool changing, etc. Write today and ask for full details of the Asquith Portable Radial.

Built in 4 sizes with radius 4 ft., 5 ft., 6 ft. or 7 ft.

WILLIAM ASQUITH LTD.
HALIFAX · ENGLAND

Member of the Asquith Machine Tool Corporation

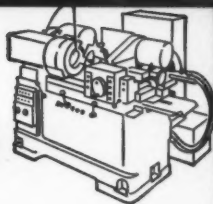
Sales and Service for the British Isles

DRUMMOND - ASQUITH LIMITED

Member of the Asquith Machine Tool Corporation

KING EDWARD HOUSE, NEW ST., BIRMINGHAM Phone: Midland 3431. Also at LONDON Phone: Trafalgar 7224 & GLASGOW Phone: Central 0922

HERE'S HOW HEALD INTERNAL GRINDERS



provide

FLEXIBILITY



● through the electro-hydraulic Universal Feed Mechanism which gives easy set-up by a simple dialling system for

● Wheel Retraction ● Start of Coarse and Fine Feeds ● Coarse and Fine Feed Rates ● Wheel Dressing Point ● Wheel Wear Compensation

Additionally, table traverse rates for dress, rough and finish grind are infinitely variable. ALL settings can be locked in position to ensure constant production.

GAGE-MATIC AND SIZE-MATIC,
PLAIN AND TOOLROOM MODELS
BELT DRIVEN WHEELHEAD UP
TO 100,000 R.P.M.

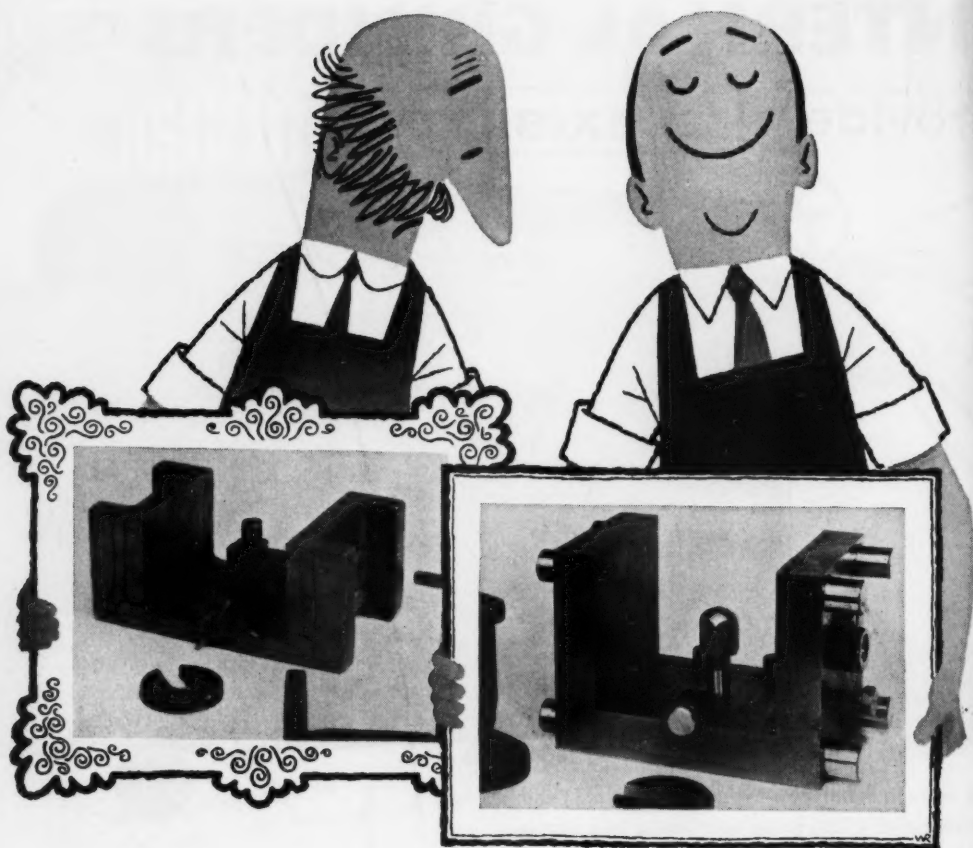
ATTACHMENTS FOR FACE
GRINDING, COMBINATION
BORE AND FACE GRINDING,
FORM GRINDING ETC.

You'll find IT PAYS to come to—

HEALD

HEALD MACHINES LIMITED • BIRMINGHAM 24 • ENGLAND
Sales Representatives • ALFRED HERBERT LIMITED • COVENTRY





Old fashioned methods of building jigs and fixtures can waste valuable time and money.

By using Purefoy Standard Parts, however, you will save money in both Drawing Office and Tool Room and be ready for production more quickly and cheaply than ever before. The jig on the right above is a typical example.

Made almost entirely from Purefoy Standard Parts, it was less than two-thirds the cost of the welded jig and the saving in time was even greater. There are several hundred items in our range and we hold large stocks of them ready for immediate delivery.

PUREFOY STANDARD PARTS

Further information, reference lists, etc., free on request to

PUREFOY UNIT TOOLING LTD., Upper Tilt Works, Cobham, Surrey.

Telephone : Cobham, Surrey 3013.

When answering advertisements kindly mention MACHINERY.

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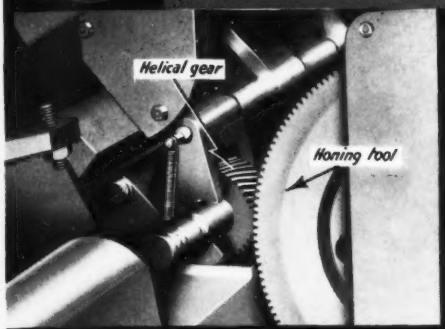
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The

Red
Ring

Honing Process Improves Gear Quality ... and reduces cost



Prior to the introduction of the "RED RING" Gear Tooth Honing Process in 1956 the only feasible means of correcting noise-producing nicks and burrs in gear teeth, required costly hand operations. Each affected gear had to be discovered and processed individually. Today gear tooth honing does the job on a fast mass-production basis at a small fraction of the former cost.



NEW "RED RING" MACHINE MODEL GHD

The honing tool, in the form of a gear, is composed of an abrasive impregnated material. This tool is meshed with the work gear in a crossed axis relationship. The tool is then operated in both directions of rotation while the work gear is reciprocated across its face in a path parallel with the gear's axis. Thus, all working surfaces of the gear teeth are subjected to honing action in accordance with true honing procedure.

Several years of continuous gear honing experience under widely varying conditions have brought the honing process as a whole into clearer perspective. Among other things, it has emphasised the importance of selective pressure control between work and tool. As a result of these findings, a new and considerably more versatile "RED RING" Gear Honing Machine (Model GHD) has now become available. In addition to increased versatility, it is smaller, more compact than its predecessor and is lower in cost.



SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY QUANTO
GEAR HONING AND ELLIPTOID

PRECISION GEAR MACHINES AND TOOLS LIMITED

(An Associate Company of National Broach & Machine Co., Detroit, U.S.A.)

World's Largest Producer of Gear Shaving Equipment

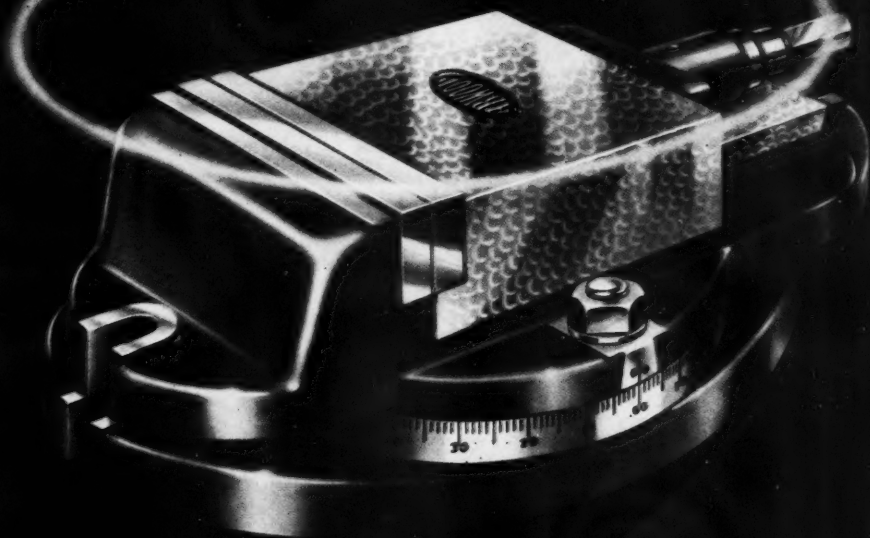
RED RING WORKS, BODMIN ROAD, WYKEN, COVENTRY

Telephone: Walsgrave-on-Sowe 2372 Telegrams: Pregearmac, Coventry.

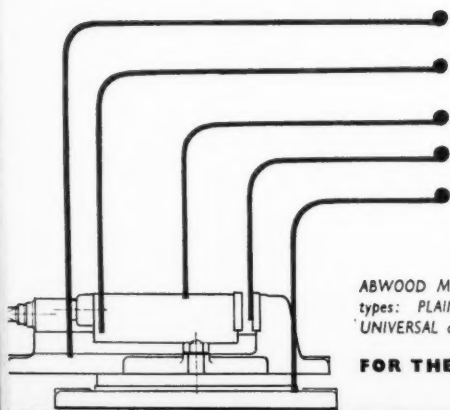
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THE VICE

with all the virtues



FOR THE TOOLROOM & PRODUCTION NO TRAPS FOR SWarf, LOW HEIGHT WITH RIGID



V SLIDES ADJUSTABLE FOR WEAR. LONG BEARING SURFACES. IMPOSSIBLE FOR THE JAW TO LIFT AND TILT THE JOB.

TOTALLY ENCLOSED SCREW WHICH CANNOT BECOME SEIZED OR BRUISED.

SLIDING JAW MACHINED OVER ITS WHOLE SURFACE FOR THE USE OF THE SCRIBING BLOCK.

GROUND TOOL STEEL JAWS AND PHOSPHOR BRONZE NUT

ACCURATELY MACHINE DIVIDED SWIVEL BASES INDEXED FULLY THROUGH 360.

ABWOOD Machine Vices are available in the following types: PLAIN, SWIVEL TYPE (illustrated), SHAPER, UNIVERSAL and UNIVERSAL COMPOUND ANGLE TABLES.

FOR THE TOOLROOM & PRODUCTION



ABWOOD MACHINE TOOLS LIMITED

PRINCES ROAD, DARTFORD, KENT

Telephone: DARTFORD 2511 (4 lines)

RIGI

FOR SPEED

Did you order 'Eclipse'?

but of course - they're the only blades we use...

AND LONG LIFE



ECLIPSE

HIGH SPEED STEEL
USE AN ECLIPSE FRAME

24

TEETH

'Eclipse' hacksaw blades and other tools are made by James Neill & Co. (Sheffield) Ltd. and are obtainable from all tool distributors.

THE BIG PEOPLE

for
**MACHINE TOOL
REBUILDING**

are...

Newman

OVER A
QUARTER OF
A CENTURY'S
EXPERIENCE

NEWMAN INDUSTRIES LIMITED

YATE · BRISTOL · ENGLAND

Telephone: Chipping Sodbury 3311



Accuracy and Dimensional Stability are guaranteed when you use Horstmann Gauges

Final measurement is carried out in a Standards Room at 20°C using equipment and master standards approved and certified by N.P.L.

Horstmann gauges are well known for their accuracy to the finest limits. They can be used with confidence, no work needing to be rejected on final inspection unless it has failed to pass the correct Reference Gauge.

To ensure dimensional stability all Gauges are hardened and subjected to N.P.L. recommended process.

Gauges are manufactured from high quality steels, selected for each particular duty, in this way giving the longest life in use.



PRECISION GAUGES

The Horstmann Test House is fully approved by the Ministry of Aviation and the War Office and it is authorised to certify and release gauges of any manufacture. Enquiries are invited.

THE HORSTMANN GEAR CO. LTD.

NEWBRIDGE WORKS · BATH · ENGLAND · TEL. 7241

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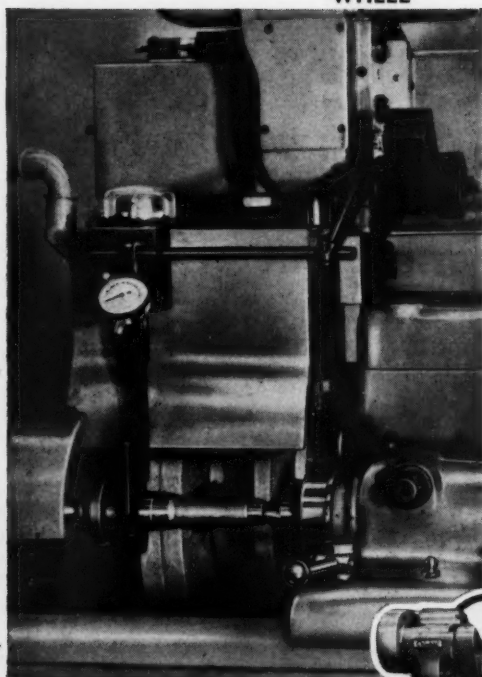
AUTOMATIC

**SIZING
OF
WORKPIECE**

**TRUING
OF
GRINDING
WHEEL**

**COMPENSATION
FOR
WHEEL
TRUING**

**CYCLE CONTROL
FOR NUMBER OF
WORKPIECES**

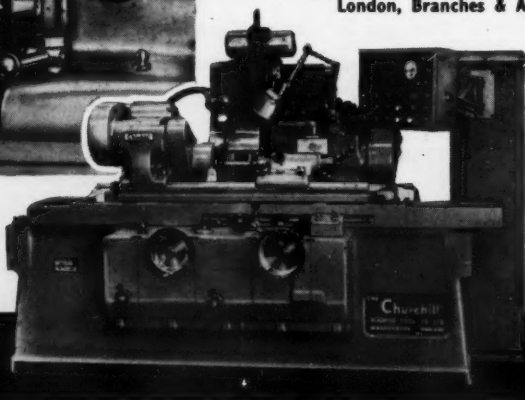


on
Model 'BW'
Plain
Grinding Machine

**THE CHURCHILL MACHINE TOOL
Broadheath, nr. Manchester. Co Ltd
Altrincham 3262**

**Export Sales Organisation
ASSOCIATED BRITISH MACHINE TOOL MAKERS LTD
London, Branches & Agents**

**Home Selling Agents
CHARLES CHURCHILL & CO. LTD
Birmingham & Branches**



BRUSSELS EXHIBITION—Churchill 'BW' Plain and 'HBM' Internal Fully Automatic Grinding Machines will be shown on Stand 2007 at the 7th European Machine Tool Exhibition, September 3rd-12th, 1961.

1957

ROL

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Ltd

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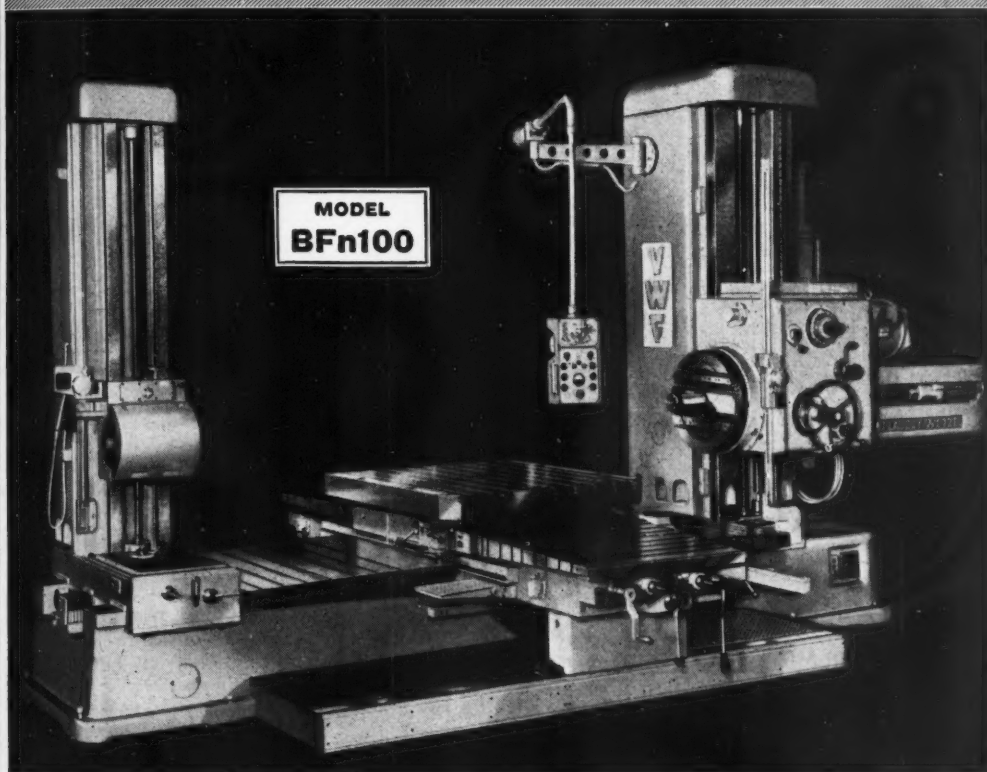
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PLAUERT-WETZEL

Horizontal Boring and Milling Machine



MODEL
BF n100

- Boring and milling spindles can be engaged individually or together, at identical or different speeds.
- Pre-selection of a wide range of spindle speeds and feeds, controlled from pendant station.
- Precision scales for co-ordinate settings, Optical fine setting equipment available as an extra.
- Rapid tool clamping in boring spindle by steep angle taper and quick-acting locknut.
- Adjustable, hardened outboard supports for the table slide; included as standard equipment.
- Fully automatic, timed lubrication of slideways, feed mechanism and spindles.

Brief description Model BF n 100

Table dimensions	50 in. x 55 in.
Table load, max.	8 tons
Distance between faceplate and steady	124 in.
Height of work spindle above table	0-55 in.
Cross and longitudinal traverse of table	69 in.
Boring spindle diameter	3.94 in.
Milling spindle diameter	7.09 in.
Boring depth in one traverse/with resetting	35/49 in.
Maximum diameter bored	35 in.
Facing diameter, max.	44 in.
Spindle speeds	9-1400 r.p.m.
Rapid traverse (all directions)	138 in./min.
Main motor	20 HP.
Weight (net, with steady)	17 tons

other models
are available

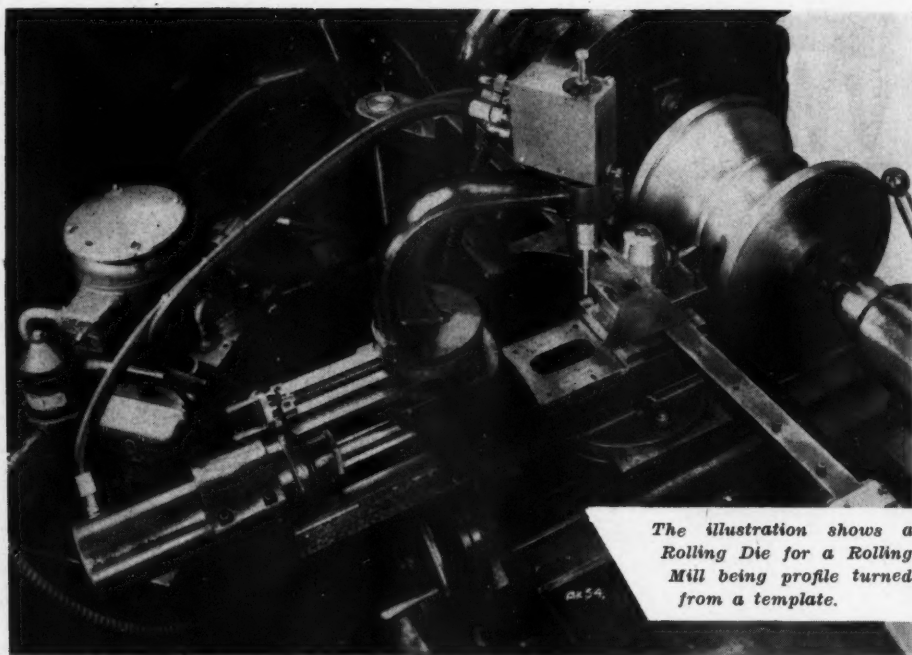
Sole British Agents

SYKES

Machine Tool Co. Ltd

Hythe Works, The Hythe
Staines, Middlesex

Telephone
Staines 55474 (5 lines)
Telegrams Sytool Staines



The illustration shows a Rolling Die for a Rolling Mill being profile turned from a template.

This illustration is the subject matter of British and Foreign Patents.

The **HYPROFILE**

UNIVERSAL HYDRAULIC DUPLICATING ATTACHMENT

**A complete portable unit easily
fitted to any standard machine
tool — uses simple sheet metal
templates — proved on production**

**Send your profiling problems and
arrange for a demonstration!**

Descriptive Catalogue supplied on request

ARMYTAGE (TOOLS) LIMITED
FOUNDRY LANE KNOTTINGLEY YORKSHIRE

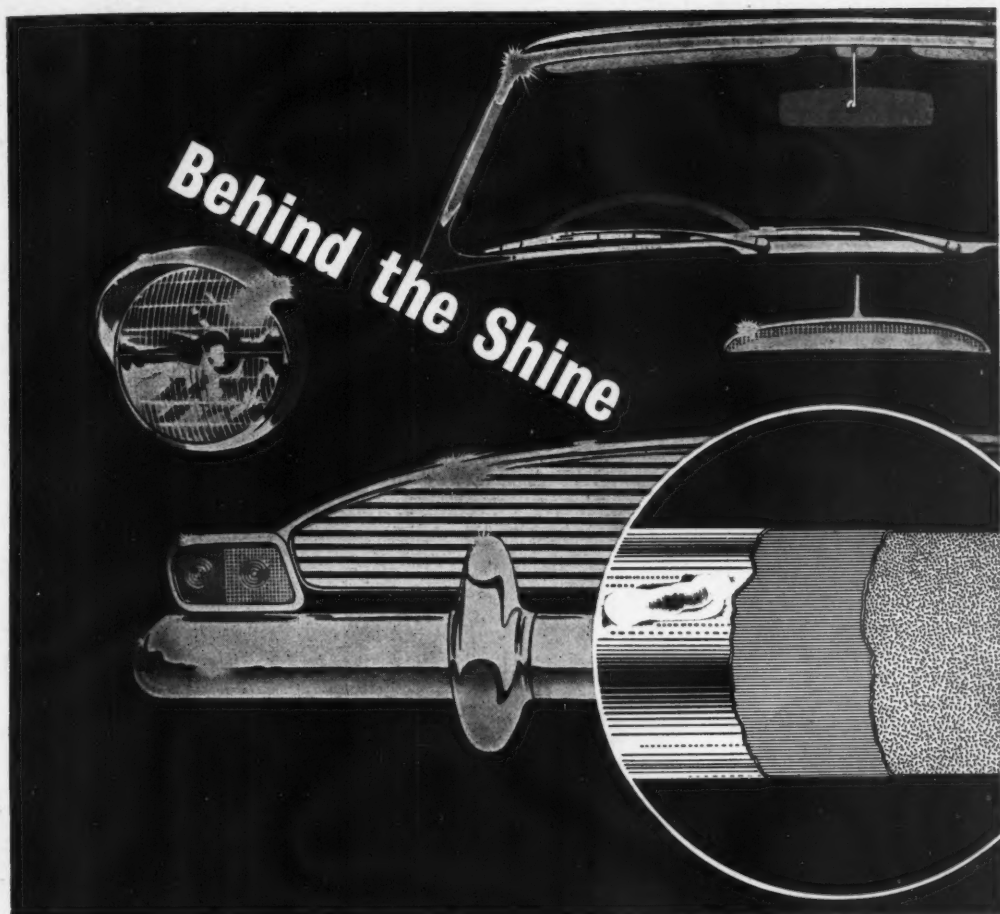
Telephone 2743/4

**THE FEATURES ILLUSTRATED ABOVE ARE THE SUBJECT
MATTER OF ONE OR MORE OF SEVERAL PATENTS**

OUTSTANDING FEATURES

1. A Universal Hydraulic Duplicator for Lathes, Shapers, Planers, Boring and Grinding Machines.
2. Low cost duplicating of parts or contours on the face, diameter, or bore.
3. Swivelling Tracer Bracket through 360° enables 90° angles and undercuts to be produced at high speed.
4. Rotating cut Control Slide through 360° allows the cut to be fed in at the required angle.
5. Any position Template Holder to suit job or the Operator, easy access for changing the template or stylus.
6. Template can be set at minimum distance from the tool, giving rigidity and accuracy in full view of the Operator.
7. Can be installed by the Operator in minutes, and fits any standard Machine Tool.
8. No brackets to make.
9. No holes to tap.
10. Ready for use on delivery.

*When answering advertisements kindly mention **MACHINERY**.*



with the **HARSHAW PERFLOW PERGLOW** DUPLEX Nickel Plating Process

THE HARSHAW CHEMICAL COMPANY, after years of research and development work, was the first to find that a sulphur-free nickel gives greater corrosion-resistance. This fact led to the development of the Harshaw Perflow nickel plating process.

Further research showed that use of the sulphur-free Perflow nickel deposit as a base coating, followed by a bright nickel deposit from a compatible bath, would give a Duplex deposit with a further improvement of corrosion-resistance.

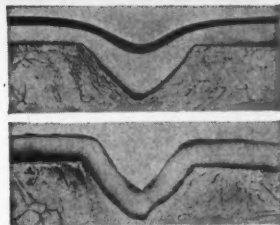
Accelerated tests and outdoor exposures by leading car manufacturers and parts suppliers indicate that the Harshaw Perflow-Perglow Duplex nickel plate is comparable to and frequently better than buffed dull nickel and is unequalled by any bright nickel. This process provides the ideal nickel base for first-quality chromium plate.

Write for details of this process to

HARSHAW CHEMICALS LIMITED

LONDON ROAD, DAVENTRY, NORTHANTS

Tel: Daventry 395 Grams: Harshaw, Daventry



The above photomicrographs demonstrate the levelling effect of Harshaw Duplex Nickel as compared to that of conventional grey nickel.
Top: Perflow-Perglow Duplex Nickel—depth of scratch 2.7 mils
Bottom: Grey Nickel—depth of scratch 2.7 mils



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PARK GATE

QUALITY STEELS FOR BRIGHT DRAWING



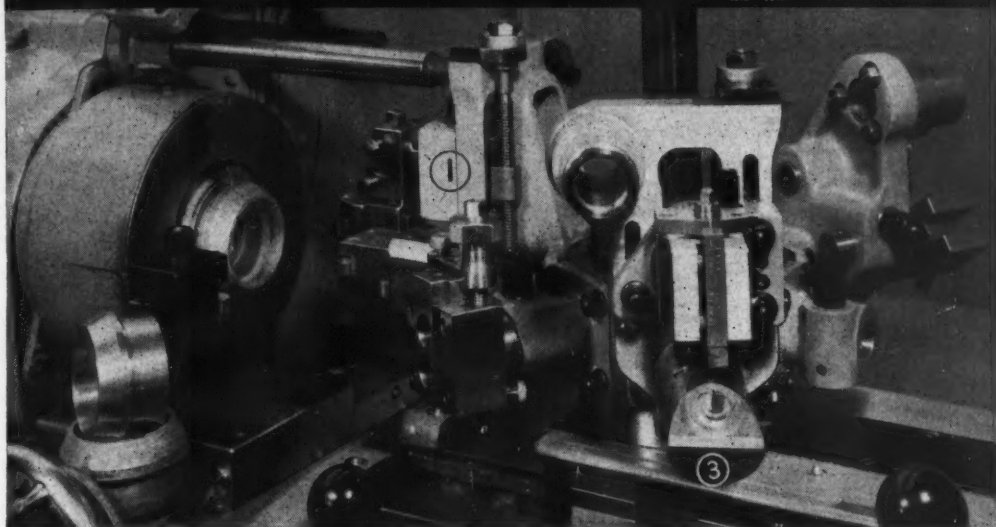
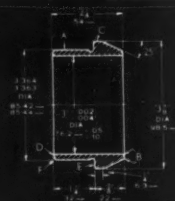
**black bars
rolled
to close limits**

THE PARK GATE IRON & STEEL COMPANY LIMITED ROTHERHAM

A  Company

TELEPHONE: ROTHERHAM 2141 (15 lines) TELEGRAMS: YORKSHIRE, PARKGATE, YORKS. TELEX: 58141

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Ward**SPECIAL****TOOLING LAYOUT No. 12****BUSH**

Machined all over.

2DS CAPSTAN LATHECode Word : **Twods**Floor to Floor Time :
1 mins. 20 secs.Equipped with $7\frac{1}{2}$ " — 3-Jaw Air Chuck.**BRASS STAMPING**Tungsten Carbide Cutting
Tools.

DESCRIPTION OF OPERATION	Tool position		Spindle Speed R.P.M.	Max. Cutting Speed		Feed	
	Hex. Turret	Cross- slide		Feet per min.	Metres per min.	Cuts per inch	m/m. per rev.
1. Chuck on "A" - - -	—	—	—	—	—	—	—
2. Rough bore 3" dia., knee turn $3\frac{7}{8}$ " dia., face end and double chamfer "B" Turn 25° taper - - -	1	Rear	1360	1430	435	214	.119
3. Reverse component in chuck and grip on "C" - - -	—	—	—	—	—	—	—
4. Face "E", form undercut, face end and chamfer "F" - - -	—	Front	1360	1380	420	Hand	Hand
5. Finish microbore 3" dia., knee turn $3\text{--}364$ " dia. and radius "D" - - -	3	—	1360	1250	380	214	.119
6. Remove - - -	—	—	—	—	—	—	—

'PRELECTOR'
Combination Turret
Lathes
with Preselective
speed-changing.

TURRET LATHES
with capacities up
to 35 in. swing over bed

1½ in. to 2½ in. **'D.S.'**
DOUBLE-SLIDE
Capstan Lathes
for heavier
accurate work.

Stock Tools,
Toolholders, Chucks
and Accessories
for Capstan and
Turret Lathes.

H. W. WARD
& CO LTD

SELLY OAK, BIRMINGHAM 29

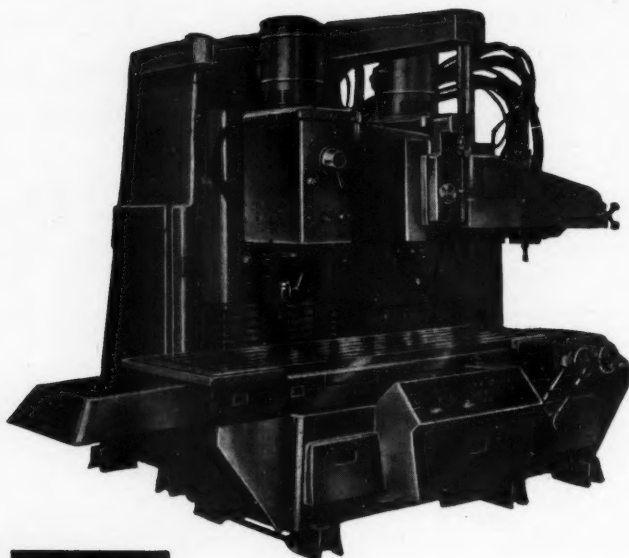
Phone: Selly Oak 1131



BRUSSELS EXHIBITION — Ward Double-Slide Capstan, Prelector and 10/13 Turret Lathes will be shown on
Stand 2102 at the 7th European Machine Tool Exhibition, Brussels, September 3 — 12, 1961

W. 605

Copies Left- and Right-hand die halves simultaneously



SWISS

RIGID

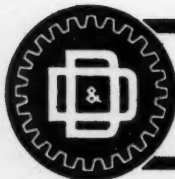
AUTOMATIC HYDROCOPYING DIE SINKER MODEL KAB 250

Fully automatic — roughing and finishing — this exceedingly robust bed-type machine copies 3-dimensional dies, without supervision, from wooden or plaster models. Both left- and right-hand halves of the die can be copied at the same time from the same master. 360° profiling can be performed at constant feed, without rotating circular tables, and on vertical contours. Servo hand control permits speedy roughing. The machine has two spindles; single- and 4-spindle machines are available also.

*Table size 130" × 25½". Spindle speeds (18) 42 to 2000 r.p.m.
Copying feeds, steplessly variable .4" to 15.75". Pick feeds .006" to .2".*

Send for fully illustrated brochure M/188.

SOLE U.K. DISTRIBUTORS:

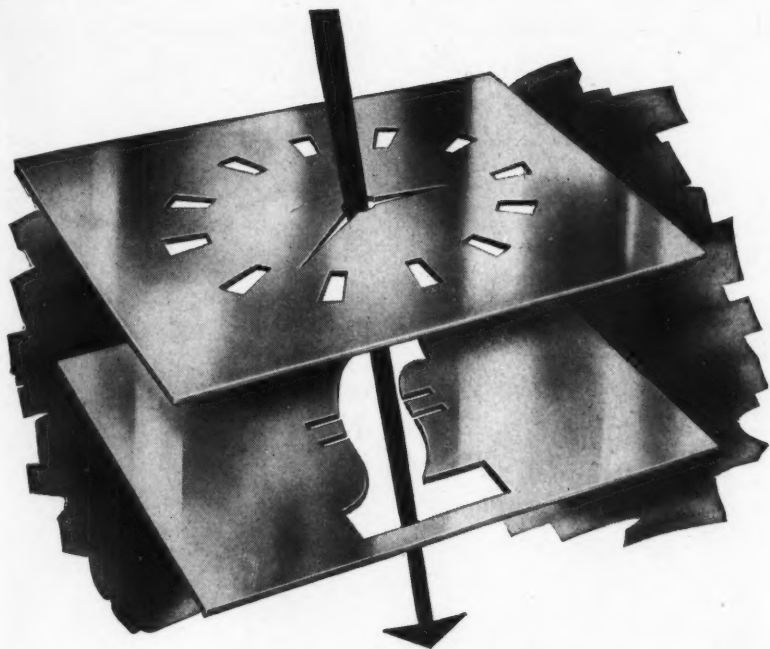


DOWDING & DOLL LTD

346 KENSINGTON HIGH STREET, LONDON, W.14

Tel: WESTERN 8877 (8 lines) Telex: 23182 Grams. ACCURATOOL LONDON TELEX

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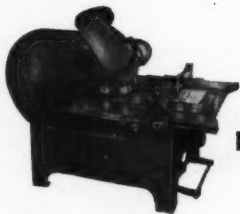


WIEDEMANN

pierces the Time and Cost Barrier

Wiedemann cuts the cost of short and medium run piercing by as much as 85% and does the job much better and much faster. No more marking out—No more setting up, drilling, fly-cutting, chiselling out or finishing to size and no more costly tooling. Modifications or complete changes of layout made quickly, easily, cheaply.

Write for Wiedemann Brochure No. M/176 and study the 'hole' time and cost question — and send sketches of some of your jobs and ask for time studies.



BRITISH WIEDEMANN TURRET PUNCH PRESSES

RA. 41P with pantograph table and stylus for rapid hole location. Throat depth 28" with 16, 18 or 20 turret stations. 30,000 lbs. capacity. Other models—hand and power operated—15,000 to 160,000 lbs. punching pressure.



DOWDING & DOLL LTD

346 KENSINGTON HIGH STREET, LONDON, W.14

Tel: WESTERN 8077 (8 lines) Telex: 23182 Grams: ACCURATOOL LONDON TELEX

*"What I really
mean to say is . . ."*



*"You mean
chucks mean Jacobs chucks
because Jacobs chucks are
the genuine chucks made by
Jacobs—the best known
name in chucks"*



*"Your dealer can supply
genuine Jacobs chucks in all sizes
for light, medium or heavy duty"*

**INSIST
ON
GENUINE**

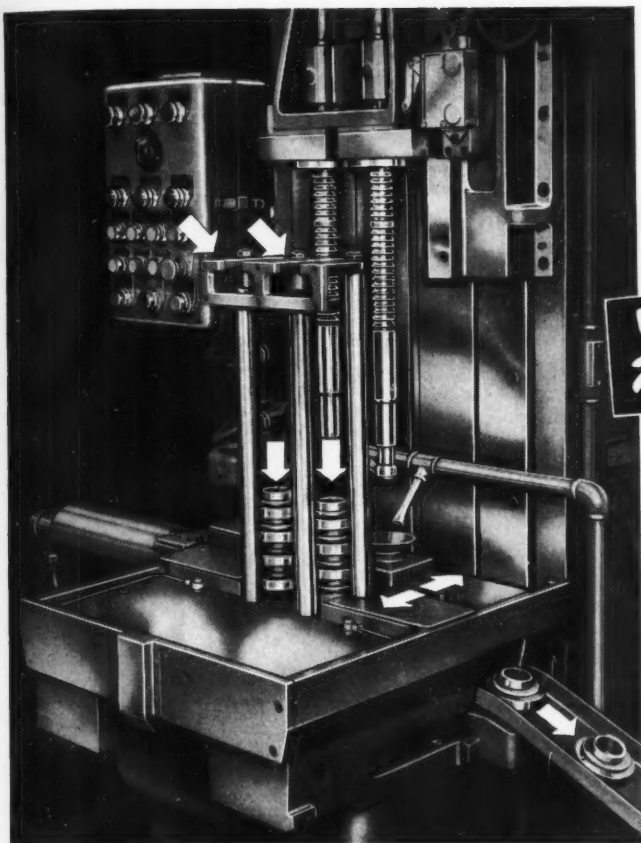
Jacobs

CHUCKS

THE JACOBS MANUFACTURING CO. LTD., ARCHER ROAD, SHEFFIELD, 8

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, 1961



FORD

OF DAGENHAM

USE

AUTOMATIC

'American'

**BROACHING
MACHINES**

BUILT & TOOLED BY

MATRIX

The above illustration shows a fully-automatic set-up for internal broaching of gears.

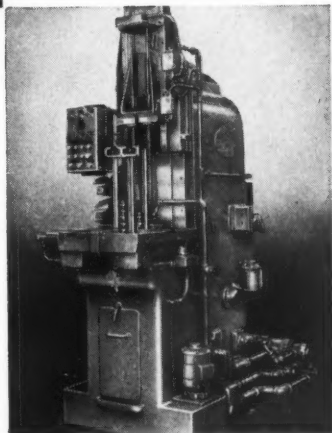
The pre-stacked components are loaded, clamped, broached and ejected automatically.

The tooling is readily converted to accommodate larger or smaller components, and is fool-proofed to guard against accidental damage.

This fully automatic, electrically controlled machine produces 200 components per hour.

Semi-automatic cycle models and untooled machines are available.

When you specify tooled-up British-built 'AMERICAN' Broaching Machines, you can be sure that the Machine, Broaches and Fixture will operate in perfect co-ordination, because they are designed that way with your particular broaching requirements in mind.



ROCKWELL
MACHINE TOOL CO. LTD.

For further particulars write or telephone TODAY

WELSH HARP, EDGWARE RD., LONDON, N.W.2. TEL: GLADSTONE 0033

ALSO AT BIRMINGHAM—TEL: SPRINGFIELD 1134/5 • STOCKPORT—TEL: STOCKPORT 5241 • GLASGOW—TEL: MERRYLEE 2822

WERNER the Standard Milling Machines with the standard features which are extra on competitive makes.

WERNER the Standard Milling Machines with practical features unobtainable on other makes, e.g. directional finger tip switches controlling all table and knee movements, automatic hydraulic clamping of slides.

WERNER the only Standard Milling Machines with automatic table cycles at no extra cost.

WERNER Standard Milling Machines are built with table sizes up to 98" x 24" with 67" travel.

WERNER Standard Milling Machines are available in horizontal, universal and vertical types.

WERNER Standard Milling Machines have so many EXTRA features.



WERNER

—the most
advanced
**STANDARD
MILLING
MACHINES**

built
AND
PROVED!

ROCKWELL
MACHINE TOOL CO. LTD.

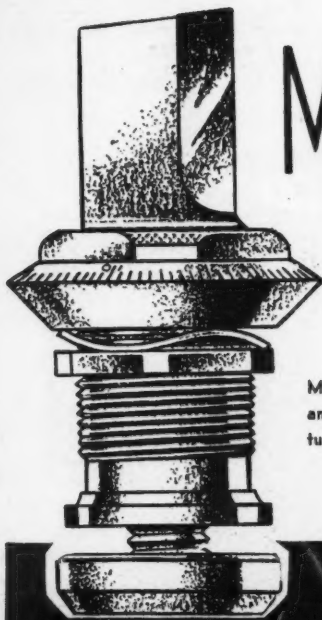
For further particulars write or telephone TODAY

WELSH HARP, EDGWARE RD., LONDON, N.W.2. TEL: GLADSTONE 0033

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July

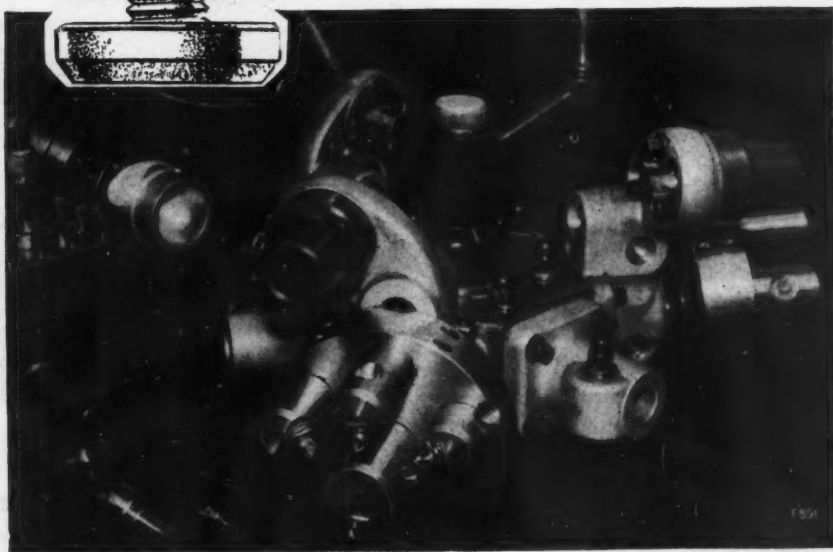
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MICROBORE

precision tooling

Microbore tooling set-up on a Herbert No. 2D capstan lathe for machining an aluminium alloy component in a total time of 60 seconds. Five diameters turned, faced and bored simultaneously using cluster tooling.



The Microbore eliminates trial-and-error methods of setting a single-point cutting tool for precision machining on lathes and boring, drilling and milling machines. Grouping these units, as illustrated, provides all the advantages of a specially-designed multi-tooling set-up but is inexpensive and is extremely flexible. Each cutting edge can be independently adjusted to micrometer precision, is easily replaceable and can be independently ground. Microbore Units or complete bars for specific set-up supplied. Six types and fifty sizes of Units available.

ALFRED

HERBERT

LTD., COVENTRY Factored Division, Red Lane Works.



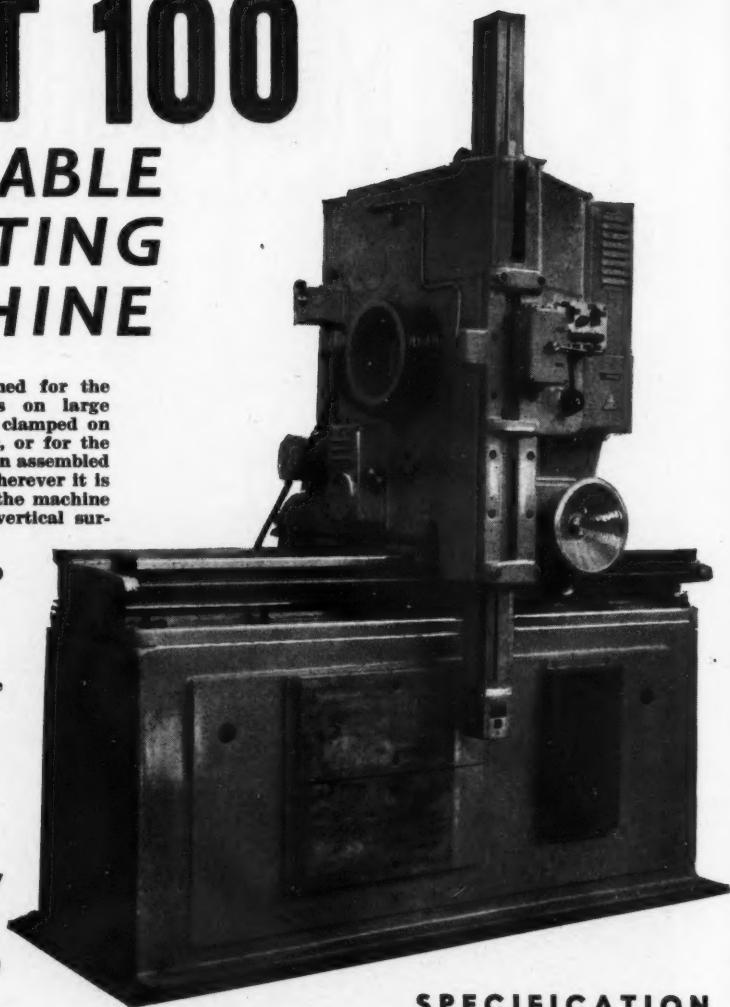
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When answering advertisements kindly mention **MACHINERY**.

HOT 100

PORTABLE SLOTTING MACHINE

The machine is designed for the machining of surfaces on large parts which cannot be clamped on standard machine tools, or for the machining of surfaces on assembled machines. It is used wherever it is advantageous to move the machine to the workpiece and vertical surfaces are machined below the level of the machine. The HOT 100 portable slotting machine is especially well-suited in heavy engineering works where it is easier to take the machine to the job than the job to the machine. It is transported by means of a crane.



Immediate Delivery
from our
Leeds Showroom
(Subject to Prior Sale)

SOLE AGENTS

SPECIFICATION

Slotting height: maximum	39½ in.	Return speed of ram per minute	52 ft.
Slotting height: minimum	1½ in.	Maximum force at all speeds	1,760 lbs.
Movement of housing on bed	59 in.	Longitudinal and cross feed per one stroke of ram	0.008 in.-0.04 in.
Transverse movement of housing	9 13/16 in.	Rapid movements of housing per minute	33 ft.
Number of ram speeds	3	Main drive motor: output	3.7 kW
Cutting speeds of ram per minute	18 ft.-26 ft.-36 ft.	Main drive motor: speed	940 r.p.m.



The Selson Machine Tool Co. Ltd

SUNBEAM ROAD, LONDON, N.W.10.

STANNINGLEY, Near LEEDS

Telephone Elgar 4000

Telephone Pudsey 2241

* And at Kingsbury (Nr. Tamworth), Manchester, Glasgow, Swansea, Newcastle-on-Tyne, Sheffield, Southampton, Belfast, Bttn.



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... for cutting spur gears and splines in shafts and slots down to .014" wide, in trick cylinders the ...



GEAR & SPLINE CUTTING MACHINE

- ★ **POWERFUL DRIVE**
- ★ **EXTREMELY RIGID AND DURABLE**
- ★ **ACCURATE INDEXING MECHANISM**

Available in both Plain and Universal form, the latter having a swivelling cutter slide enabling spur or bevel gears to be cut and other angular work index milled.

Capacities	Plain	Universal
Max. diameter	36"	24"
Max. stroke of cutter slide	8"	4½"
Max. pitch, Cast Iron	5 D.P.	5 D.P.
" " Steel	6 D.P.	6 D.P.



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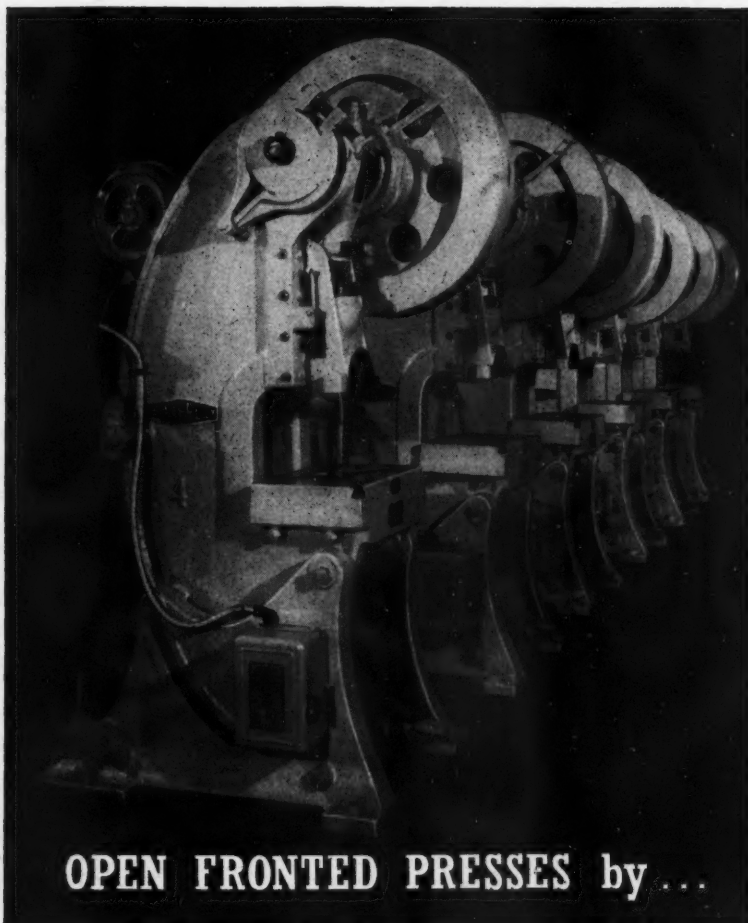
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LTD., COVENTRY Factored Division, Red Lane Works.



AD 649

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BUTTERLEY

The Butterley range of sheet metal machinery includes geared and ungeared power presses, guillotine shears, press brakes and general machinery for the hot and cold working of metals.

All castings are made by the MEEHANITE process in our own well-equipped foundries. The Butterley foundries are available for the production of high-grade MEEHANITE castings to customers' requirements.

We invite your enquiries for MEEHANITE castings of all grades up to 20 tons.

The word MEEHANITE is a registered trade mark.

Full details of Butterley Sheet Metal Machinery supplied on request . . .

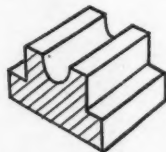
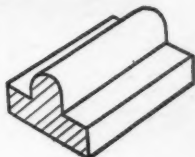
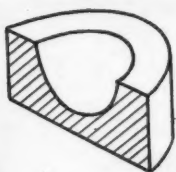
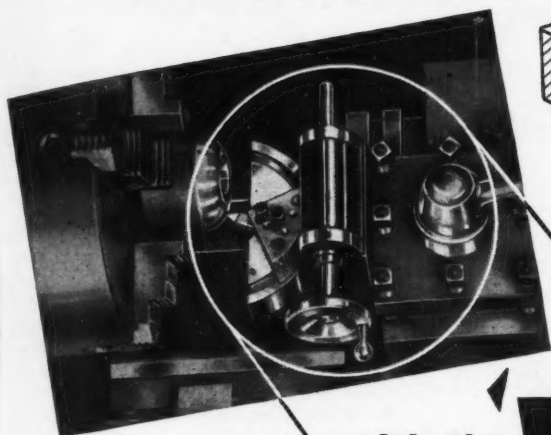
THE BUTTERLEY COMPANY LIMITED, RIPLEY, DERBY, ENGLAND. Tel.: RIPLEY 411 (9 lines)

London Office: 9 Upper Belgrave Street, S.W.1. Tel.: SLOane 8172/3

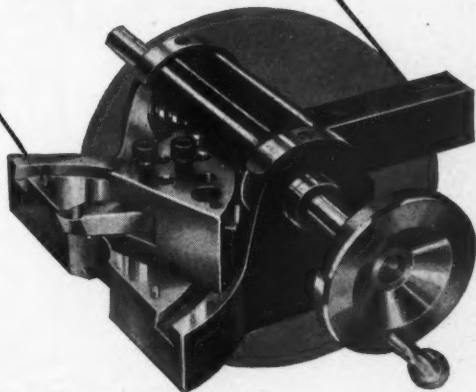
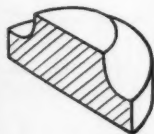
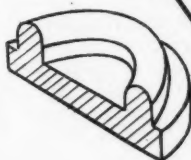
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SM20

Adapt your Lathes and Shapers for ***SPHERICAL TURNING...***



with the **'HABIT'** **TURN-A-ROUND** SPHERICAL TURNING ATTACHMENT



Accurate spherical turning and convex and concave radius forming on lathes and shapers is simplicity itself with the TURN-A-ROUND — another HABIT toolroom innovation. Clamp it in the toolpost — set it with the aid of a simple chart — and turn the handle. A full 90° radius can be produced in one setting, or with twin tool bits — 180° of arc can be covered. The HABIT TURN-A-ROUND is versatile, robust, needs no special skill and will prove to be a vital part of every toolroom's equipment and every turners' kit.

Write for technical literature

HABIT GEOMETRIC TOOLING
LURGAN AVENUE : LONDON W.6
TELEPHONE : FULHAM 7944

Look for the Little Flag!

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Visit us on Stand
6103, HALL 6
7th European Machine Tool
Exhibition, Brussels,
September 3-12



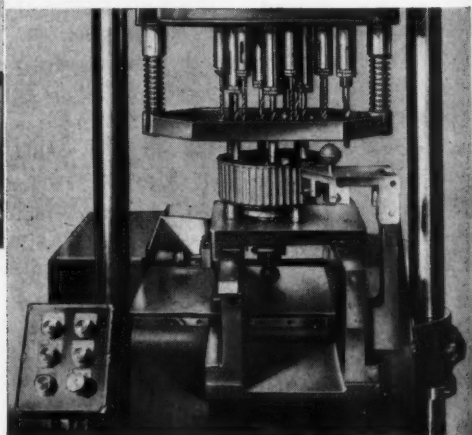
Hydraulic Multi-spindle drilling machines

These hydraulic up-stroking multi-spindle drilling machines provide fast approach, accurately controlled drilling feed and fast return of the worktable after completion of drilling. They are extremely flexible in use and can be fitted with driving motors of up to 15 h.p. — the thrust available from standard machines can be varied up to 8,000 lbs.

The machine illustrated is one of two recently supplied to a customer for the quantity production of Brake components. Provision is made for fast changeover of multi-spindle Heads and tooling, and the machines were supplied complete with all necessary jigs and fixtures built to customer's requirements.

'Patterning' of multi-spindles enables one machine to cater for a number of different parts — Heads with up to 90 spindles are in course of production.

A complete range of fixed centre and adjustable type multi-spindle Heads for attachment to existing machines, together with a comprehensive tooling service are also available.



Write for full particulars to:

W. J. MEDDINGS LTD
IPSWICH ROAD • TRADING ESTATE • SLOUGH • BUCKS
Telephone: Slough 26761 (5 lines)

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7th European Machine Tool Exhibition,
Brussels, September 3rd to 12th, 1961

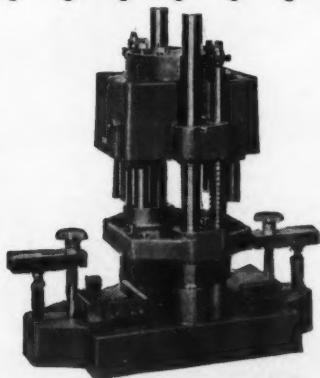
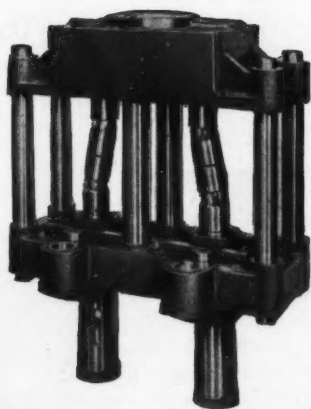
LET'S PUT OUR HEADS TOGETHER ON YOUR DRILLING PROBLEM



We supply precision built multi-spindle drilling and tapping

Heads to suit your machine—for light, medium or heavy work and with spindles up to No. 5 M.T. Geared, gearless and adjustable types are available to meet your requirements.

Additionally, we can supply complete tooling, fixtures, bushplates etc. for your particular application. We design and build special-purpose machines incorporating multi-spindle Heads to meet your own specific needs.



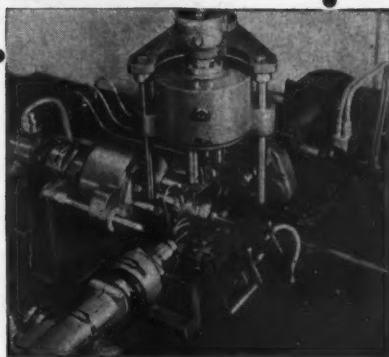
W.J. MEDDINGS

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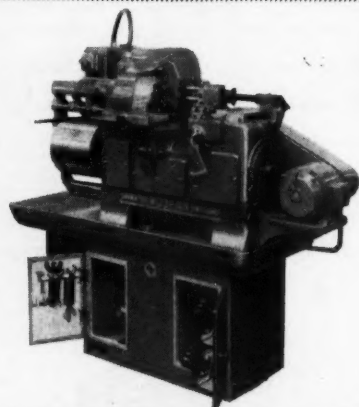
Phone: Slough 26761 (5 lines)



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Simple Setting—High Production

with **MODERN** automatics



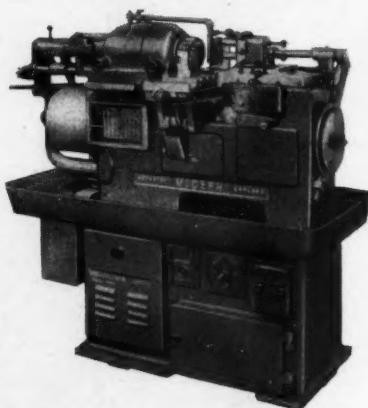
TYPE 904

CAPACITY

Round Bars, Dia. ...	...	...	$\frac{3}{4}$ "
Hexagon Bars, A/F ...	...	...	0.71"
Square Bars, A/F ...	...	...	$\frac{7}{16}$ "
Maximum Travel of Tailslide ...	...	...	2"
Maximum Travel of cross slide ...	...	...	$1\frac{1}{8}$ "

SPINDLE SPEEDS

Speed Range ...	...	...	810-2,500 r.p.m.
No. of Speeds ...	...	...	14



TYPE 907

CAPACITY

Round Bars, Dia. ...	...	...	1 $\frac{1}{2}$ "
Hexagon Bars, A/F ...	...	...	1.01"
Square Bars, A/F ...	...	...	$\frac{7}{8}$ "
Maximum Travel of Tailslide ...	...	...	2 $\frac{1}{2}$ "
Maximum Travel of cross slide ...	...	...	1 $\frac{1}{2}$ "

SPINDLE SPEEDS

Speed Range ...	...	...	280-1,900 r.p.m.
No. of Speeds ...	...	...	12



Modern Machine Tools Ltd

P. O. BOX 56 • GOSFORD STREET • COVENTRY

Telephone : Coventry 22132/6

Cables : 'Modern' Coventry

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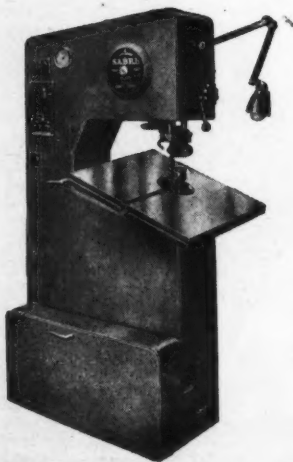
BAND SAWING

the efficient way of cutting

The Startrite SP.147s 18" Throat Bandsaw with 5½" under guides. 8-speeds 75 to 3,800 ft./min. Saw guides, with hardened steel inserts and anti-friction ball bearing thrust collar. Cast iron table tilts 45° right 5° left. Interchangeable disc type wheels with bonded tyres.



The Startrite-Sabre 20" Throat Band-sawing-Filing-Polishing Machine, with 8" under guides. 10 speeds 65 to 3,700 ft./min., or 47 to 2,700 ft./min. In-built butt welder and grinder, Job selector, low-volt spotlight. Chip blower. Auto-set upper and lower guides with ball bearing thrust collar. 4-way table tilt. Blade tension indicating dial. Angle guides available which eliminate throat restriction when cutting bars, tubes, sections, etc.



The Startrite-Meba Horizontal cut-off Bandsaw. Model SM.250—10" capacity; SM.320—12½" capacity. Outstanding features include fine hydraulic blade feed control, quick acting vice clamping mechanism, graduated vice jaws swivel through 45°. Infinitely variable blade speed 46 to 235 ft./min. Transmission through gear box and cone drive pulleys. Complete coolant system. Over-load protected switch gear which automatically stops on completion of cut.

- these machines can be obtained from

STANCROFT LIMITED

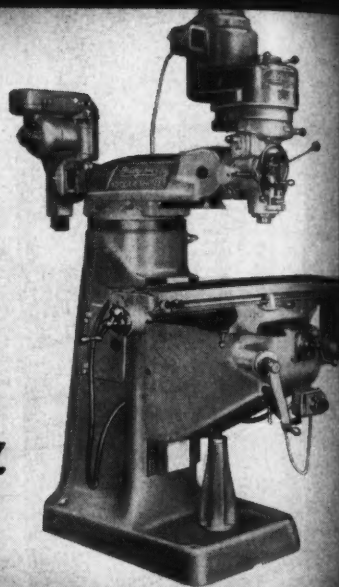
LANCASTER STREET, BIRMINGHAM, 4
Telephone: ASTON CROSS 2235-6-7-8-9
72 DUDLEY ROAD, WOLVERHAMPTON
Telephone: WOLVERHAMPTON 25661
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Telephone: COVENTRY 88072-3

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July 26, 1961

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- ★ You can buy extra Bridgeport attachments out of the profits the basic machine earns.
- ★ Almost every machine shop in the U.S. has at least one Bridgeport: yet demand has exceeded supply for twenty years.
- ★ The genuine Bridgeport is now also made in Britain—with the most efficient large-scale production techniques. So *the price is incredibly low* . . . and demand is—naturally—high. Delivery is 'first come, first served'—so get your order off now!

Bridgeport



-the miller that is more universal than any 'universal'



2

of a series showing applications of this versatile machine

Right angle milling for the difficult or nearly impossible job.

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only the
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offers so much

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A & S

ADCOCK & SHIPLEY LIMITED
P.O. Box 22, Ash Street, Leicester.



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ALL
**THESE INTERNAL FORMS
ARE EASY WITH A...**
FRÖMAG

KEYSEATER

There is a FROMAG Keyseater to suit your requirements whether keyways are from $\frac{1}{4}$ " to 10" wide, up to 98" in length, bores from $\frac{1}{2}$ " to 59" diameter can be handled.

This range of machines are economic units whether for mass production, small batch quantities or single parts, where high accuracy, efficiency and speed are a necessity. They can handle small pinions with $\frac{1}{2}$ " bore to ships' propellers with 5' bores weighing 30 tons.

Model KZ.50 for keyways from $\frac{1}{4}$ " to 12" in width and up to 17 $\frac{1}{2}$ " length.



Even 25% utilisation makes the FROMAG Machines an economic proposition. A combined tilting and floating table can be supplied for cutting keyways in cylindrical bores and for keywaying taper bores. The larger machines can also be used as vertical broaching machines, 6-ton capacity.

MORTIMER

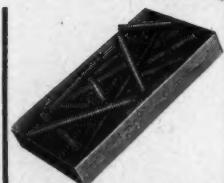
EXCLUSIVE
DISTRIBUTORS OF THE FINEST MACHINE TOOLS

MORTIMER MACHINE TOOL CO. LTD · MORTIMER HOUSE · ACTON LANE · LONDON NW10 · Tel: ELGar 3834-5-6

NRP 5000A

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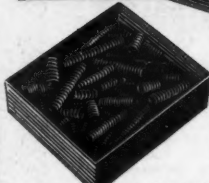
EXPERIMENTAL SPRINGS?



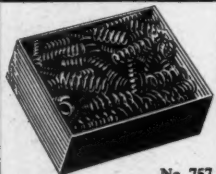
No. 1200
Three dozen Assorted Light
Expansion Springs, suitable for
carburettor control, etc. 15/-.



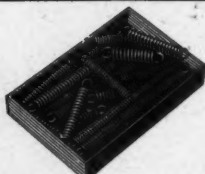
No. 760
Three dozen Assorted Light
Compression Springs. 1" to 4" long,
22 to 18 S.W.G., $\frac{1}{8}$ " to $\frac{1}{4}$ " diam. 7/6.



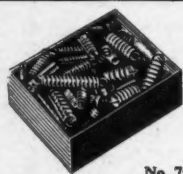
No. 98A
Three dozen Assorted 1" to 4"
long, $\frac{1}{8}$ " to $\frac{1}{4}$ " diam., 19G to
15G. 6/6.



No. 757
Extra Light Compression, 1
gross Assorted, $\frac{1}{8}$ " to $\frac{1}{4}$ " diam.,
1" to 2 1/2" long, 27 to 19 S.W.G.
18/-.



No. 753
Three dozen Assorted Light
Expansion $\frac{1}{8}$ " to $\frac{1}{4}$ " diam., 2" to 6"
long, 22 to 18 S.W.G. 12/-.

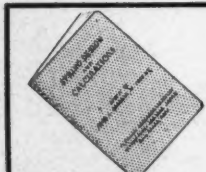


No. 758
Fine Expansion Springs. 1
gross Assorted $\frac{1}{8}$ " to $\frac{1}{4}$ " diam.,
1" to 2" long, 27 to 20 S.W.G.
18/-.

That spring you want . . . in a hurry . . . where is it? Pick what you want, when you want it, from TERRY'S BOXES OF ASSORTED SPRINGS—our fine range of small boxed assortments of experimental springs. We can show you only a few from the range here. Send a postcard for our full list—and if ever you're stuck with a spring problem send it along to our Research Department—they'll gladly help you out.

Have you a Presswork problem?

If so, the help of our Design Staff is yours for the asking.



Really interested in Springs? "Spring Design and Calculations" 10th Edition tells all—post free 12/6.



Cut Production Costs with Terry's Wire CIRCLIPS. We can supply immediately from stock—from $\frac{1}{8}$ " to $\frac{1}{4}$ ".



Looking for good Hose Clips? Send for a Sample of Terry's Security Worm Drive Hose Clip and price list.

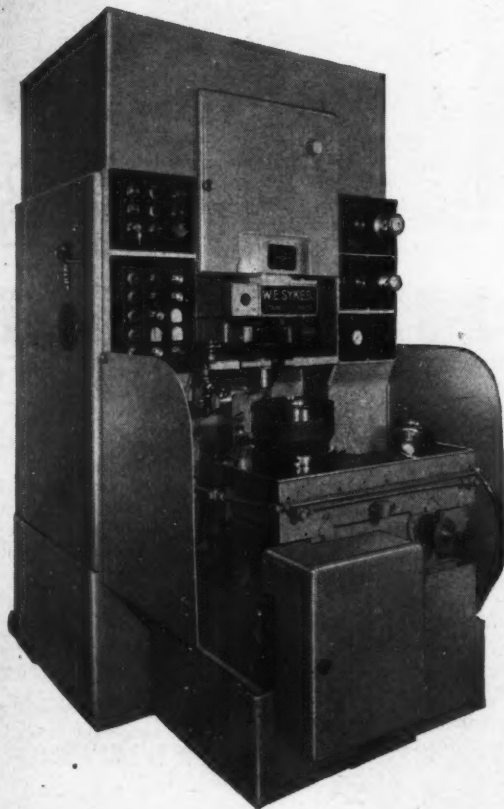
**HERBERT TERRY
& SONS LTD.**
Redditch, Worcs.

(Makers of Quality Springs,
Wireforms and Presswork for
over 100 years.)

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Talk to Sykes about the VIOB... for medium batch production



V10B Vertical Gear Generators are available in Semi-Automatic models for the medium or large batch production of Internal or External gears. A pre-set cycle and interlocked hydraulic work clamping relieves the operator of all attention except for component loading. Automatic cutter 'lift' or 'stop at top of stroke' allows simple foolproof loading of Internal gears and permits optimum cutting speeds to be used.

Infinitely variable speeds and feeds. Switch selected 1, 2 or 3 cut hydraulic Infeed. Autocycle, including rapid saddle traverse and adjustable drop-off point. Visual indication of progress of cycle. Sizing control switch for rapid checking after cutter change. Constant, pre-set, hydraulic Infeed, independent of component diameter. Adjustable off-set saddle for maximum feed rates. PLUS... Automation; by coupling into conveyor type system.

Alternatively a number of machines can be linked into a continuous production line.

If you would like to know more about the unique features of the V10B Semi-Auto models, write for a copy of brochure P18/60.



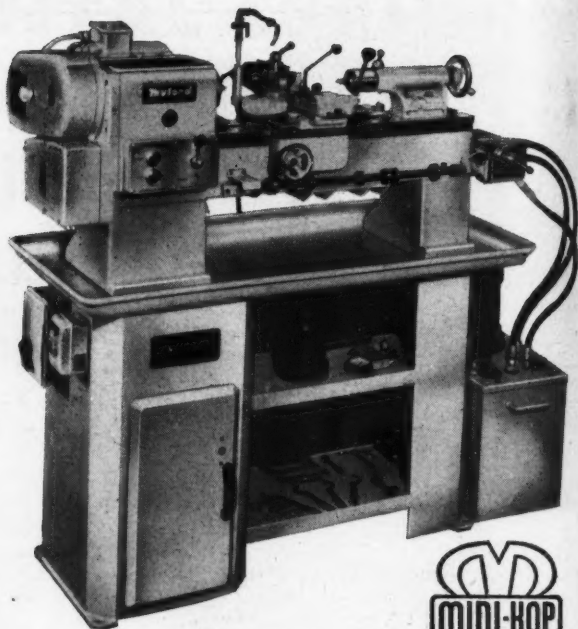
W. E. SYKES LIMITED • STAINES • MIDDLESEX • ENGLAND

and associated companies:

Sykes Tool Corporation Ltd., Windsor, Ontario, Canada. Sykes Machine & Gear Corporation, Detroit, Michigan, U.S.A. W. E. Sykes Ltd., Mascot, Sydney, NSW, Australia.

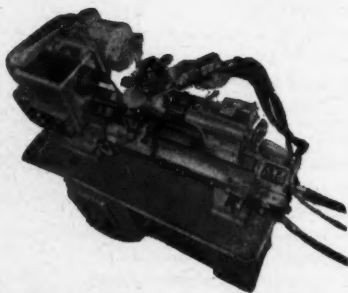
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**a
high-speed
hydraulic
copying
lathe
for small
parts**



Myford MINI-KOP

SERIES 1A



Specifically designed for copy-turning small components up to 1 inch diameter. This is a fully hydraulic machine with hardened bed . . . hydraulic carriage motion has instantly variable feed-rate control and fast traverse in either direction . . . alternative reproducer approach angles . . . and many other features to facilitate small component copying.

Automatic length stops accurate within 0.001 inch.
Will reproduce steps as small as 0.0005 inch.
Will reproduce profiles within 0.001 inch on the diameter.
Will repeat diameters well within 0.001 inch.
Spindle speeds to over 4,000 r.p.m.
Costs little more than many copying attachments.

Please write for further information to



myford Ltd

BEESTON NOTTINGHAM
TEL: NOTTINGHAM 254222

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a GOOD START for a GOOD FINISH

There's a very good case for paying particular attention to the finish of a product—before you commence production. And you can pay no more particular attention than by installing a White Junior model T.O.P. Speedfinisher.

Here's an abrasive belt machine which finish grinds components at a prodigious speed. On steel and alloy strip for table tops and shop fittings, on hand and pocket knives and a wide range of metal products up to 18" wide, the Speedfinisher gives consistently good results. Demonstration? With pleasure.

- ★ Floorspace only 28" x 35"
- ★ Variable speeds—20 - 54 f/m.
- ★ Automatic belt tracking rolls.
- ★ Abrasive belt length 72"
- ★ Belt replaced in 2 mins.
- ★ Exhaust hood/guard combined.
- ★ Improved stock removal by spirally-serrated, rubber-covered abrasive contact roll.



THOMAS WHITE & SONS LTD.

LAIGHPARK, PAISLEY, SCOTLAND. Tel: Paisley 3137

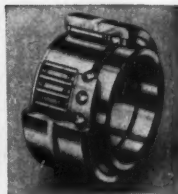
LONDON OFFICE: CLIFTON HOUSE, EUSTON ROAD, N.W.1. Tel: Euston 4196/7



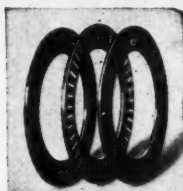
Ina Needle Cage



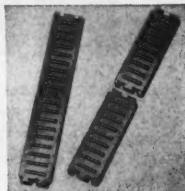
Ina Needle Bearing

Ina Combined Bearing
(NKX Series)Ina Combined Bearing
(NKIB Series)

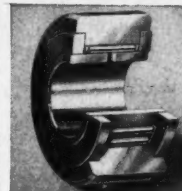
CAGE GUIDED NEEDLE BEARINGS



Ina Thrust Bearing



Ina Flat Cage

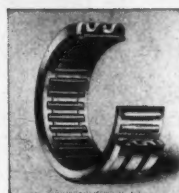
Ina Roller Follower
(NATR Series)

Ina Cam Follower

introduce new principles into engineering

- Space saving advantages resulting in economic design.
- Even load distribution with maximum rigidity of mounting.
- High peripheral speeds.
- Bearings range from shaft diameters of 4-390 mm.
- Over 3,000 types and sizes kept in stock.

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Ina Adjustable Bearing



Ina Shell Type Bearing

INA NEEDLE BEARINGS LTD

Head Office and Factory: Dept. M, Dafen, Llanelly.

Tel: Llanelly 4312/6. Telex: 4816.

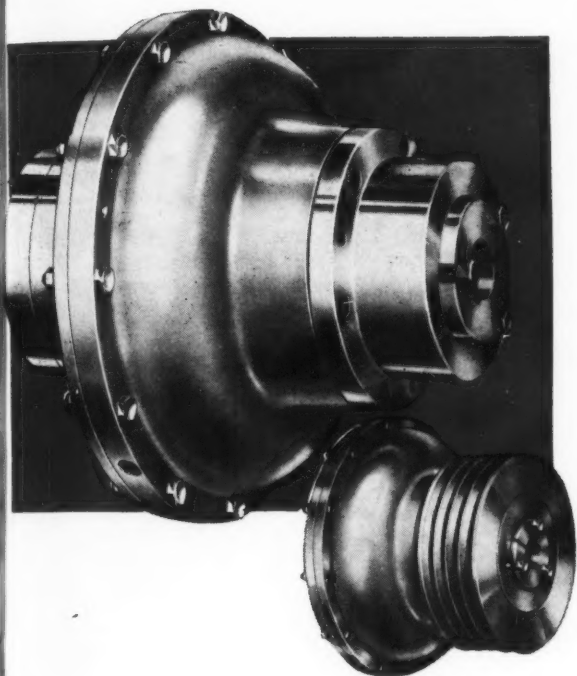


Ina Bearings are manufactured in Great Britain, France, Brazil and Western Germany.

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cushioned running

ALL ALONG THE LINE!



That's your production line when you use Crofts Patent 'Free-Space' Hydraulic Couplings and Drives. For smooth, controlled acceleration to full speed and cushioned stall-proof drive you can't beat 'em. When you think of hydraulic couplings and you need easy fitting, quick alignment, neater arrangement and reduced driving costs, there's only one answer—Crofts 'Free-Space' Hydraulic Couplings and Drives—they're unbeatable. And every drive is **guaranteed!**

STANDARD RANGE FROM $\frac{1}{2}$ h.p. at 1440 r.p.m. to 700 h.p. at 875 r.p.m.

This reply-paid card will bring a copy of Publication 460, giving more details of Crofts 'Free Space' Hydraulic Couplings and Drives, by return. Use it also to obtain details of Crofts Flexible Couplings shown overleaf.

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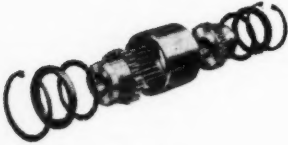
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THORNBURY
BRADFORD 3
YORKSHIRE



FLEXIBLE COUPLINGS

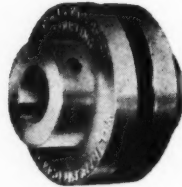
NTS Internal Gear Flexible Couplings



Up to 800 h.p. at 100 r.p.m.
Coupled or uncoupled in a few seconds.

Publication 5736AB.

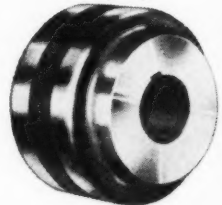
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Fractional to 15 h.p. at 1,440 r.p.m.
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Disc Type Flexible Couplings



Fractional to 54 h.p. at 100 r.p.m.
An ideal, medium power, shock absorber.

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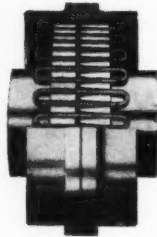
MB Internal Gear Flexible Couplings



Up to 30,000 h.p. at 100 r.p.m.
For heavy duty industrial drives.

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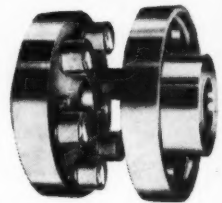
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Up to 5,000 h.p. at 100 r.p.m.
Suitable for high or low speeds.

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Fractional to 3,500 h.p. at 100 r.p.m.
Suitable for virtually every application.

Publication 5730.



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THREE-PHASE IS THE FUTURE WELDING TECHNIQUE...

... and it's here **TODAY** to rid you of power supply problems. Balanced load conditions and better than 80% power factor see to that. But more important, Sciaky Patent 'Three-Phase' brings positive welding advantages, ensures consistency of weld quality at a given control setting throughout the longest production run and permits complex electronic programming for welding 'difficult' metals. 'Three-Phase' with its characteristic progressive current rise and inherent lack of skin effect also greatly extends electrode tip life, and the need to stop production for dressing is far less frequent.

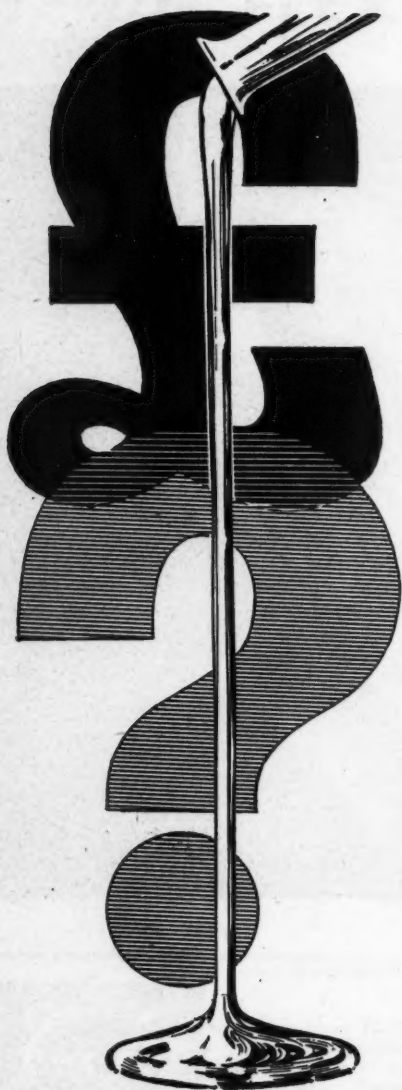
The consistency of welding produced by Sciaky Patent 'Three-Phase' is such, that wherever quality and product finish are important—only Sciaky 'Three-Phase' resistance welding machines are seriously considered for top quality results... In resistance welding Sciaky Patent 'Three-Phase' takes care of the future... **TODAY**

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SCI AKY ELECTRIC WELDING MACHINES LTD • SLOUGH • BUCKS • Telephone: SLOUGH 25551 (10 lines)

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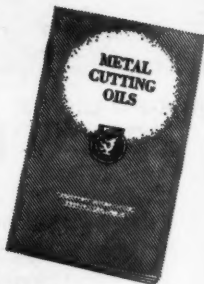
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Increasing quantities of 6", 10" and 16" wide medium capacity, medium duty strip levellers are being built for stock. Increasing demand keeps the stock down to a minimum but we can generally offer attractive delivery for these machines. Many famous industrial concerns have standardized on Humphris press shop equipment to the exclusion of all other makes. We also welcome enquiries for machines outside our standard range.



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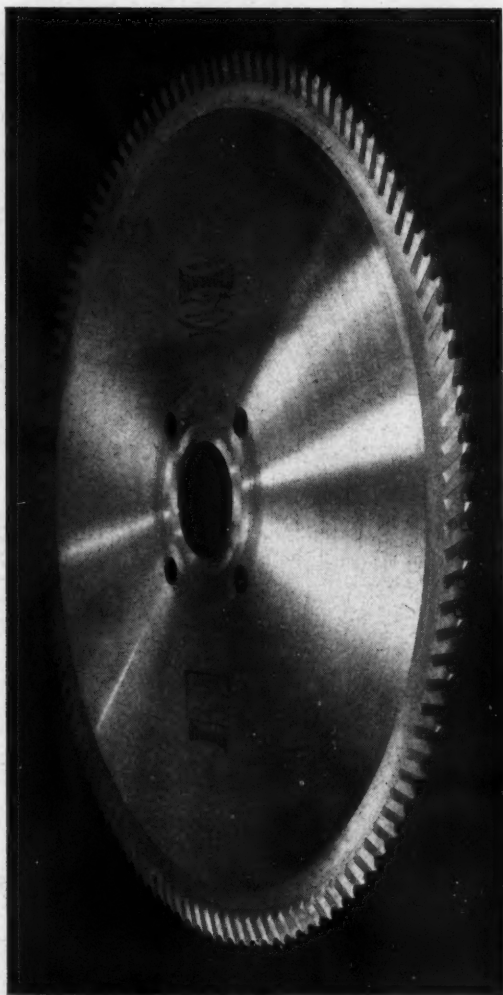
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TELEPHONE: POOLE 1800

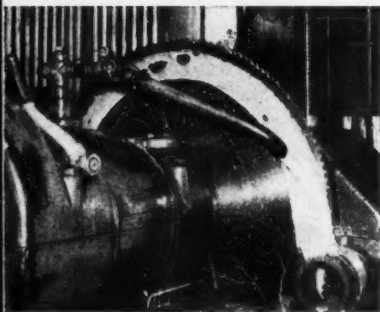
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The NEWBOULD segmental saw

The scientific tooth design of the NEWBOULD segmental saw enables ferrous and non-ferrous metals to be cut at maximum feeds and speeds. Alternate roughing and finishing teeth produce free-curling, easily-cleared chips, reducing friction, minimising power wastage.

Made in sizes from 11" to 60" diameter with tooth segments of SABEN EXTRA high speed steel for maximum life between re-grinds.

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EXPORTERS OF A WIDE RANGE
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LATHES,
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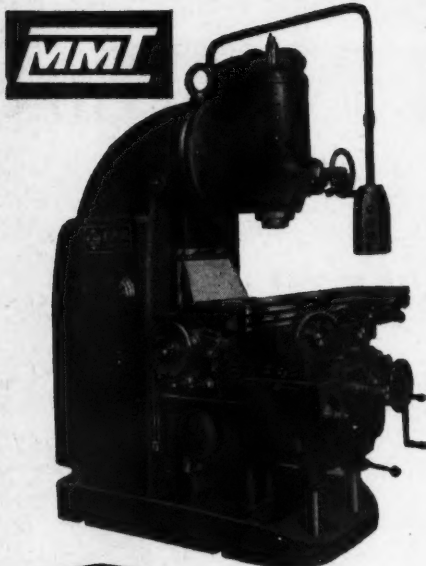
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MACHINE TOOL AGENCIES LIMITED

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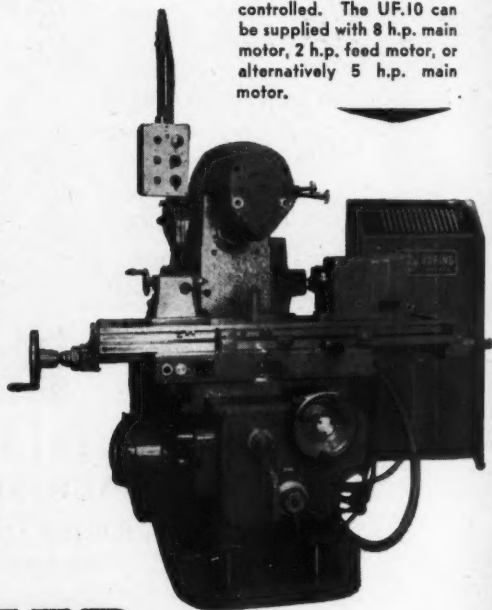


New VF.20 Vertical Milling Machine featuring the swivelling head with independent motor drive for power feed to quill, enabling power feed of quill to be obtained at any angle desired. This is a valuable feature especially in repetitive drilling and boring. Main spindle motor 15 h.p., feed motor $3\frac{1}{2}$ h.p., special feed motor for spindle quill $\frac{1}{2}$ h.p.

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*Lead the
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The UF.10 illustrated with automatic cycle programme control including rise and fall of knee and indexing. All machines supplied with double front support to knee giving maximum support under the heaviest cut. Range includes universal, plain, vertical, auto-cycle and auto-cycle programme controlled. The UF.10 can be supplied with 8 h.p. main motor, 2 h.p. feed motor, or alternatively 5 h.p. main motor.



Also world-renowned manufacturers of high precision heavy duty lathes, 45 models from 8" height of centres to 20" height of centres, 40" between centres to 120" between centres. Larger machines manufactured to special requirements.

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MORE FOR YOUR £

Material cost per item is less than that of other non ferrous metals.

Clean modern appearance.

Can be anodised—clear or colour.

Automatics can operate at maximum feeds and speeds.

Small chips eliminate swarf “build up” at tool tip.

Write TODAY for Full Technical Details.

Specify
**ALMINAL
152**

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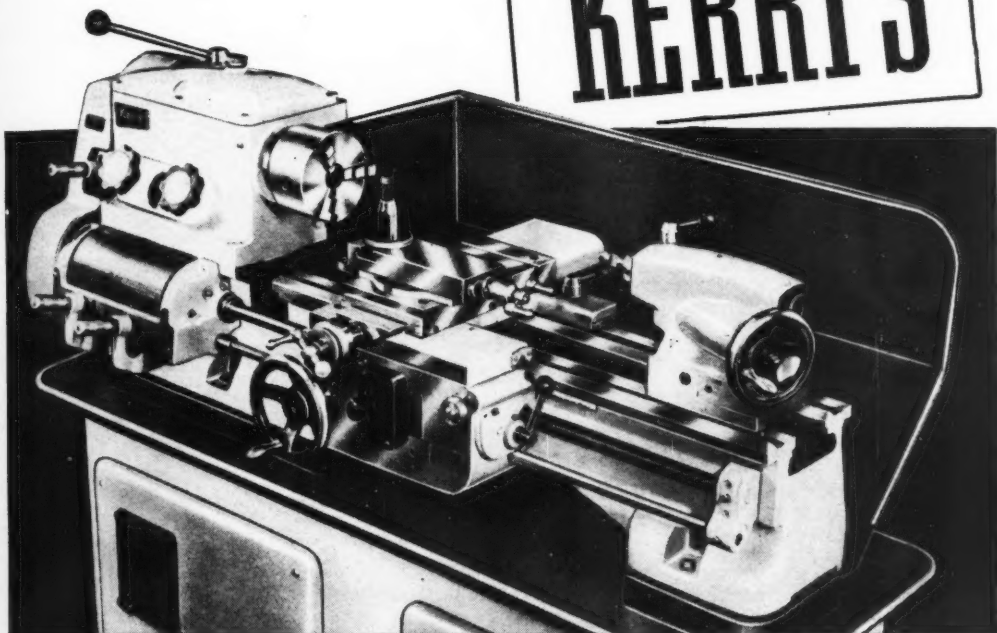
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**MORE AND MORE
ARE TURNING TO**

KERRY'S



11" SWING LATHES

*THOUSANDS in use in Great Britain
and throughout the World!*

- ★ SLIDING, SURFACING AND SCREWCUTTING LATHE
- ★ ALL GEARED HEADSTOCK GIVING 9 SPEEDS RANGING FROM 39-1500 r.p.m.
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- ★ BEDWAYS AND SLIDES PRECISION GROUND
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a Kerry COMPANY

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HEAVY DUTY Vertical BORING & TURNING MILLS

with 5, 6, 8 or 10 ft diameter work tables

These incomparable machines are massively constructed for years of hard service. Accuracy and dependability are of the high order that industry has learned to expect of Broadbent Machine Tools. Notable features of these Boring and Turning Mills include twelve changes of speed and six changes of feed, controllable from either side of the machine; spiral bevel and spur reduction gears driving the work table; pendant control of rams and cross slides; and rapid power traverse with independent control of the two heads.

Please write for fully illustrated brochure.



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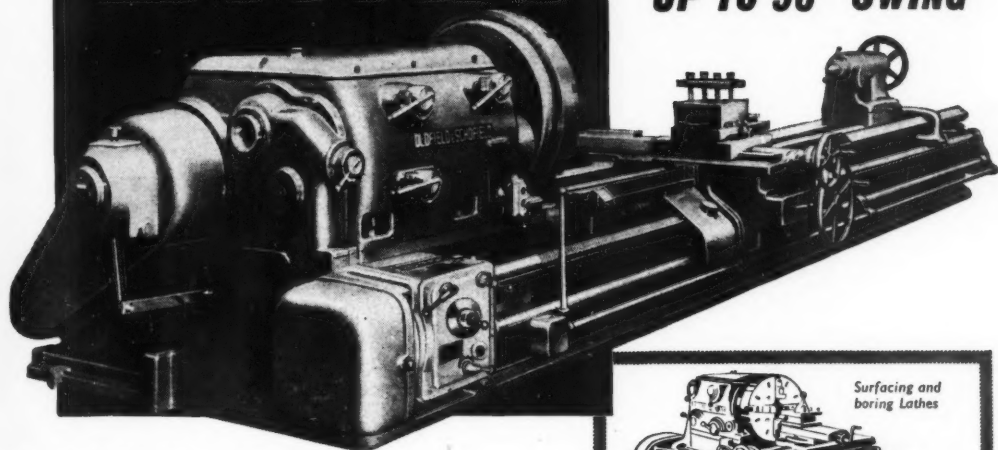
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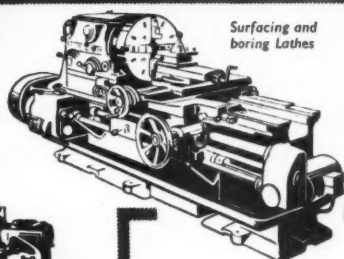
Heavy Duty LATHES



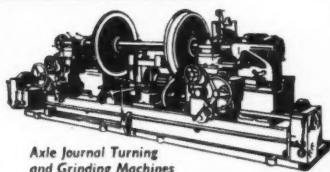
UP TO 96" SWING



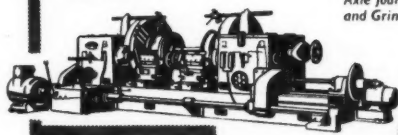
18½" Centre 'D' Type Lathes. Built in sizes up to 48" swing.



Surfacing and boring Lathes



Axle Journal Turning and Grinding Machines



Heavy Duty Double Wheel Lathe

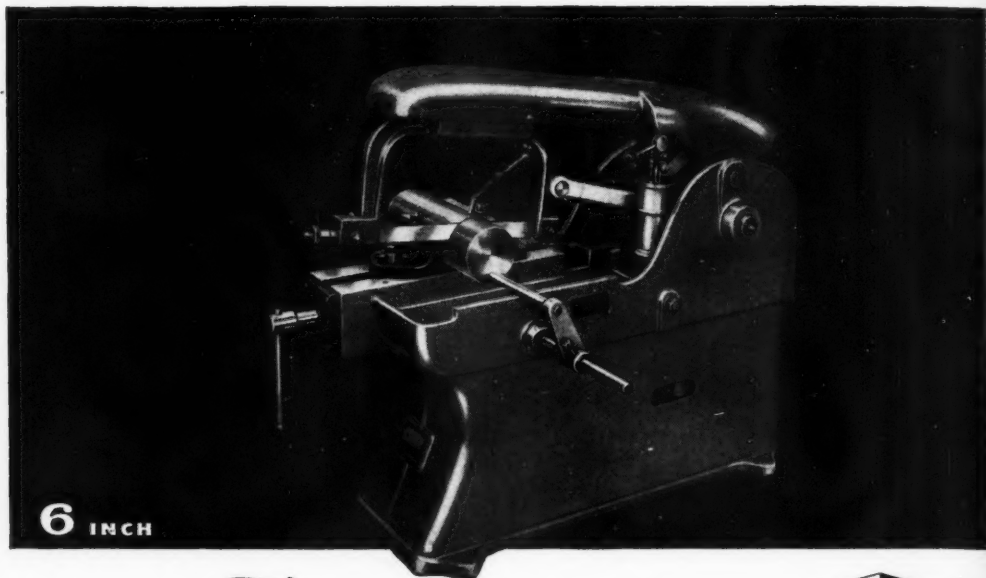
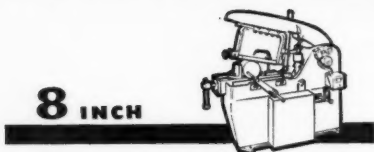
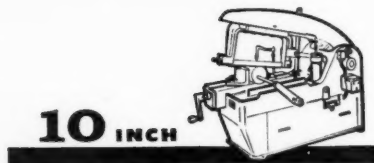
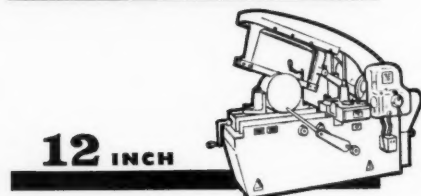
O & S have for many years manufactured a wide variety of heavy lathes which have earned for the company a fine reputation for precision engineering and first class craftsmanship. The range includes Surfacing and Boring Lathes up to 96" swing, Brake Lathes, Axle Lathes, railway carriage and waggon wheel lathes, axle journal turning and burnishing lathes etc., all embodying the latest developments in modern lathe design.



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A Kerry Company

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**6** INCH**8** INCH**10** INCH**12** INCH

Full details from
your machine tool
merchant or
our Sales Office

The Famous **Q&S**

SAWMASTERS

**are the finest
HEAVY DUTY HACKSAWS
in the world**

Modern in design, robust and precise in construction, these unrivalled machine saws cut accurately and rapidly, and offer maximum production efficiency. Refinements include totally enclosed drive, hydraulic relief on the return stroke and automatic lifting of the bowslide to loading position on completion of cut.

Instant lever selection of correct cutting speed is a feature of all but the smallest model.

—and the famous *SAWMASTER* Autocut Power Bandsaw.



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**Superb
performance
Attractive
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Quick
delivery**

All models complete with Standard Equipment including :

- Cos-par Universal Dividing Head
- Vertical Milling Attachment
- Arbor
- Front Support Braces

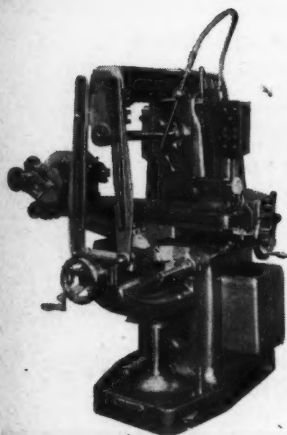
Specification :

Model	No. 0	No. 1	No. 2
Table	34" x 8½"	39½" x 9"	48" x 11"
Long. Trav.	20"	26"	29"
No. of Speeds	12	9	18
Speeds R.P.M.	32-1000	60-1200	40-2000
Spindle Nose	No. 40	No. 40	No. 40
PRICE ★	£880	£1100	£1825

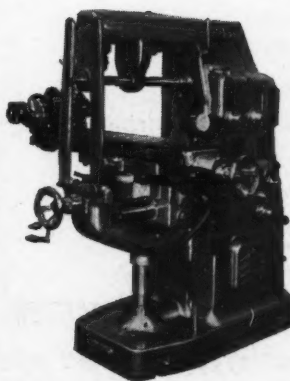


UNIVERSAL MILLING MACHINES

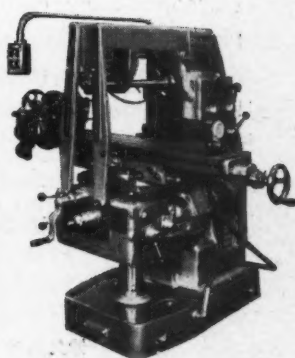
Model 0



Model 1



Model 2

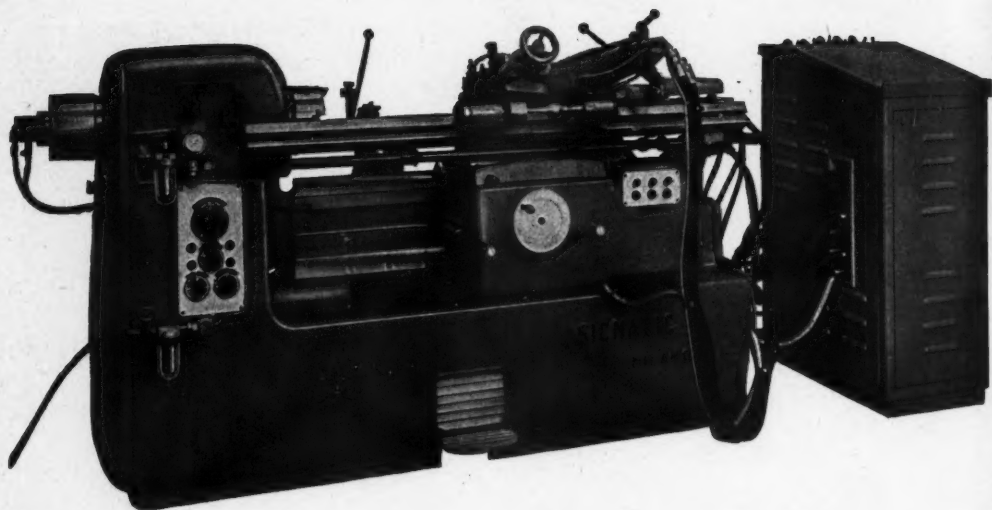


★ Special terms
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The new SICMATIC

AUTOMATIC & SEMI-AUTOMATIC HYDRAULIC PROFILING LATHES

Duplomatic Hydraulic System.
Hardened Bed Slideways.
Auto cycling up to six depths of cut.
Hydraulic tailstock for drilling and boring.
Uses template or existing component.
Eight models to choose from.

Basic price under £2,000.

SPECIFICATION

Bore of spindle ..	2½ in.
Spindle nose ..	5 in. A.S.A.
Max. swing over bed ..	15½ in.
Max. swing over saddle ..	9½ in.
Max. length turned ..	27½ in.
Hydraulic traverse of copying slide ..	4 in.
Hydraulic feed of tailstock spindle ..	4½ in.
Number of feed rates to copying slide ..	48
Max. tool pressure ..	1,300 lbs.

EARLY DELIVERY

DAILY DEMONSTRATIONS AT OUR WORKS:

**HERBERT WIDDOWSON & SONS LIMITED
CANAL STREET WORKS NOTTINGHAM**

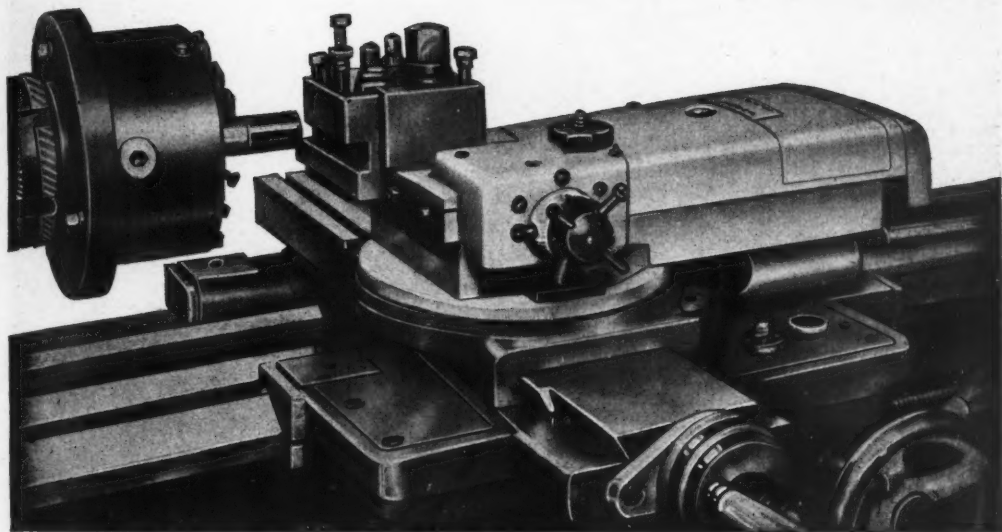
TELEPHONE: 51891 (3 lines)

TELEGRAMS: TOOLS NOTTINGHAM

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FILEMATIC

high speed THREAD CUTTING ATTACHMENT



**Write today
for complete
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revolutionary
attachment**

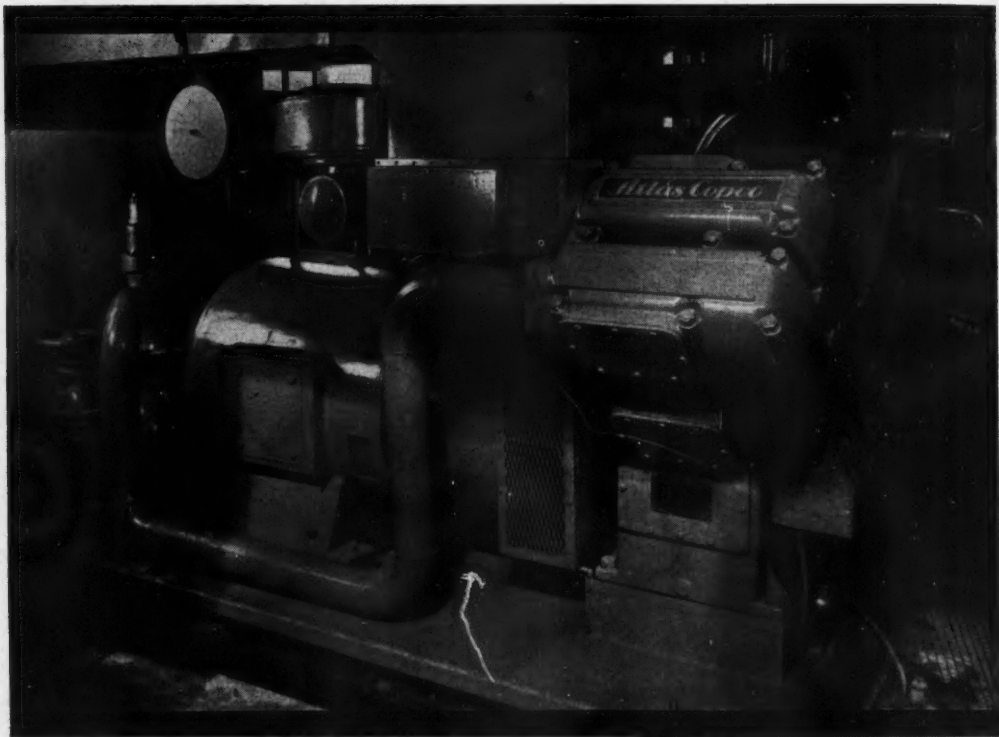


- ▶ **FITS ANY CENTRE LATHE**
- ▶ **CUTS ANY THREAD...
INTERNAL OR EXTERNAL
CYLINDRICAL OR TAPER**
- ▶ **MAXIMUM LENGTH 1½ in.
MAXIMUM PITCH 5.T.P.I.**
- ▶ **THREAD RIGHT UP
TO A SHOULDER...
INSTANT WITHDRAWAL**
- ▶ **EQUALLY SUITABLE FOR
SHORT RUNS OR
LARGE SCALE PRODUCTION**

HERBERT WIDDOWSON & SONS, LTD
CANAL STREET WORKS · NOTTINGHAM · ENGLAND

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RIGHT FROM THE WORD 'GO' ...



... the DT4 compressor looks after itself

Here's a compressor you can install—and then forget about. Suitable for 24 hours a day continuous operation. The DT4 delivers 565 cfm, and is a fully air-cooled, short-stroke, two-stage machine. Weighing 2,200 lb. it occupies 30-50% less space than most compressors of similar capacity. No special base is needed, it can be fitted with a frame mounting and rubber feet, thus enabling it to be moved from place to place. The DT4's compact design allows easy passage through mine shafts, drifts and similar places. It is an ideal compressor for mining and contracting work.

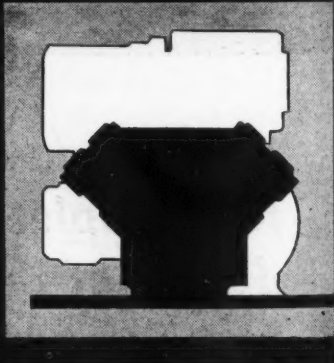
Important Space Savings

The economy in space offered by the Atlas Copco DT4 is convincingly demonstrated by the silhouette of a DT4 (shown right) superimposed on the outline of a conventional compressor of equal capacity. For further information on the DT4, write for a copy of leaflet E1208. It is readily available from your local Atlas Copco branch or from the address below.

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Maylands Avenue, Hemel Hempstead, Herts. Tel: Boxmoor 6040

Sales and service depots: LONDON · BRISTOL · CARDIFF · LICHFIELD · LEEDS
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5/113

Atlas Copco

puts compressed air
to work for the world

When answering advertisements kindly mention MACHINERY.

For competitive plunge or through-feed grinding, and to tenths

Wickman Scrivener



This machine offers accuracy of grinding, quality of finish, and economy of production under the most exacting conditions. With a grinding capacity up to $\frac{1}{4}$ " diameter at maximum production rates and 1" for batch work, the No. '0' machine caters for most classes of small work. Many standard features normally regarded as extras contribute to operating efficiency and together with a patented controlled-cycle system for plunge grinding this machine is today's best proposition in small centreless grinders.

If you have a centreless grinding problem — share it with us!

Centreless Grinding Machine

Brief specification:

Maximum opening, new wheels, hand-operated machine	1½"
Maximum opening, new wheels, controlled-cycle machine	1½"
Grinding wheel size, diameter x width	12" x 3"
Control wheel size, diameter x width	7" x 3"

Some standard features.

- ★ Separate hydraulic form truing attachments to both wheels.
- ★ Anti-friction rollers to diamond dressing attachment for positive truing of grinding wheel.
- ★ Universal workrest for through-feed and plunge feed workplates.

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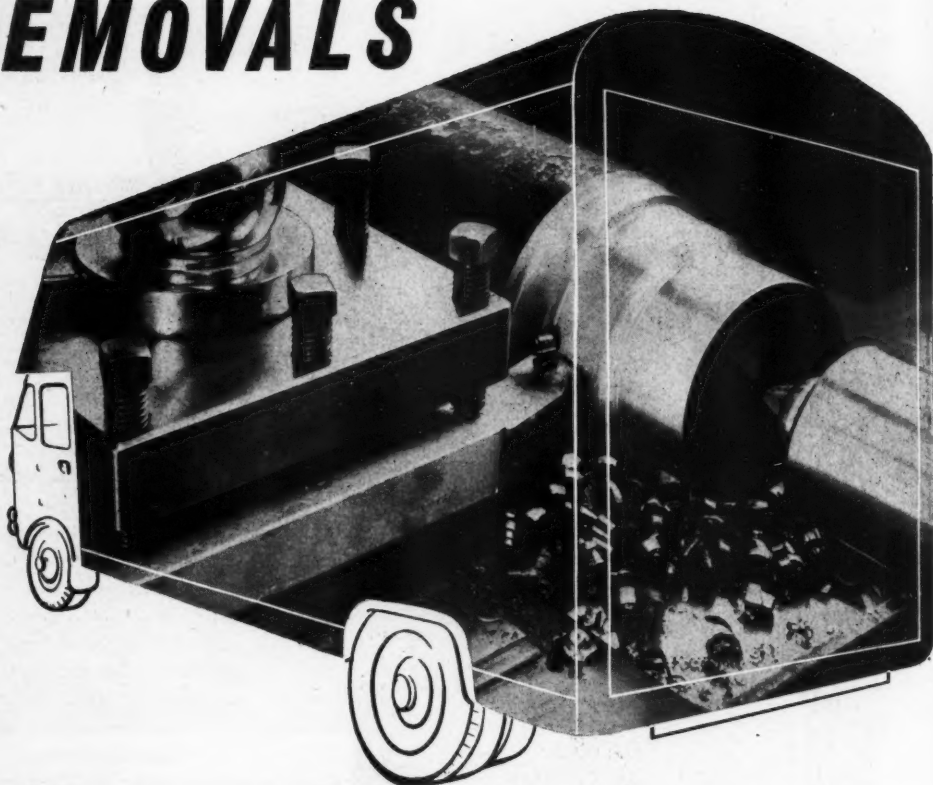
FACTORED MACHINE TOOL DIVISION, BANNER LANE, COVENTRY

Telephone: Tile Hill 65231

S40 F20/80

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FOR REALLY FAST REMOVALS



VANLEDA HIGH SPEED STEEL

Five per cent of Vanadium, in addition to Cobalt, makes Vanleda one of the most valuable steels in the modern machine shop. Possessed of a very high resistance to abrasion its use for single point tools on high speed automatic lathes has met with outstanding success. Here it has proved to be superior to the more conventional cobalt high speed steels. Nevertheless it is but one of the famous range of Firth Brown high speed steels to which section seven of the Firth Brown catalogue is a complete guide. A copy of section seven is yours for the asking.



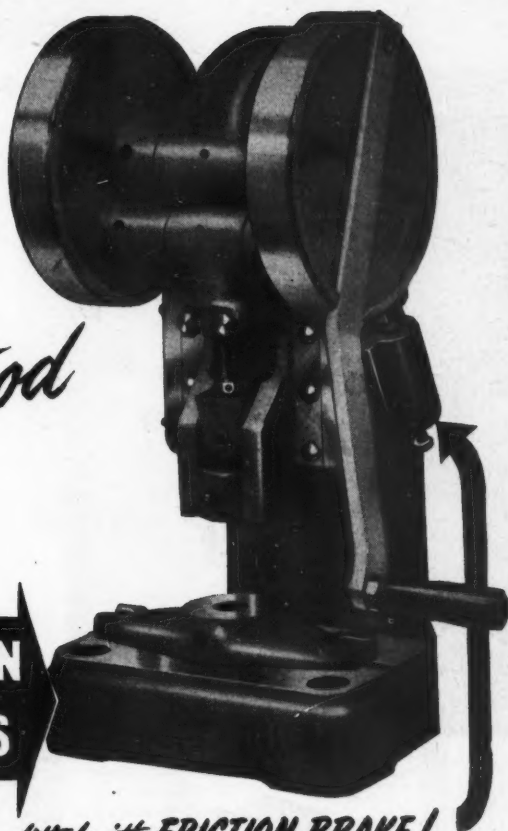
ALLOY STEELMAKERS . FORGEMASTERS . STEEL FOUNDERS . HEAVY ENGINEERS
THOS FIRTH & JOHN BROWN LIMITED SHEFFIELD ENGLAND

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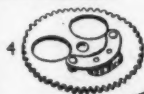
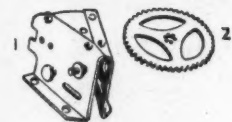
TOGGLE ACTION

*the Faster
Modern Method*

**S&B TOGGLE ACTION
BENCH PRESS**



fitted with FRICTION BRAKE!



1. Three hollow rivets and single ball end rivet fastened. Single operation.

4. Hollow rivets on saddle fastened. Single operation.

2. Wheel stabbed to form keys. Single operation.

5. Forming on Strap holders.

3. Crop form after Auto turning. Pierce holes and form Location Studs. Pierce centre hole. Pierce the two smaller holes and crop form at small end.

		H.3	H.5
Capacity	...	1 ton	2 ton
Throat to centre of Ram	...	2 1/2 in.	3 1/2 in.
Maximum daylight	...	3 1/2 in.	5 1/2 in.
Stroke	...	1 1/2 in.	2 1/2 in.

Machines available from all Machine Tool Merchants.

S&B

SMART & BROWN (MACHINE TOOLS) LTD.
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Telephone: WELBECK 7941 (PBX)

Cables: SMARTOOL, WESDO, LONDON

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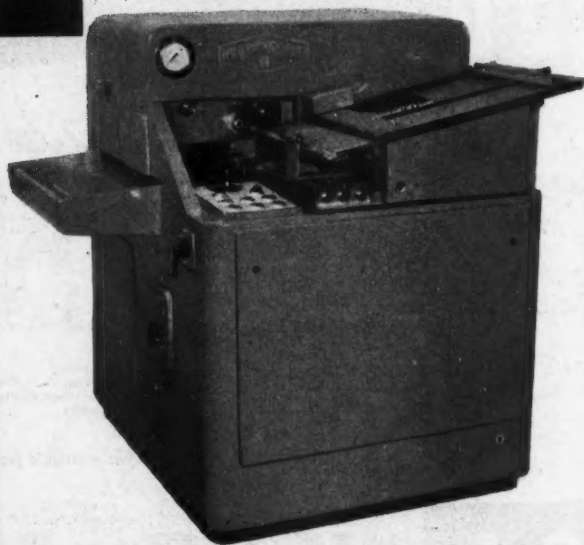
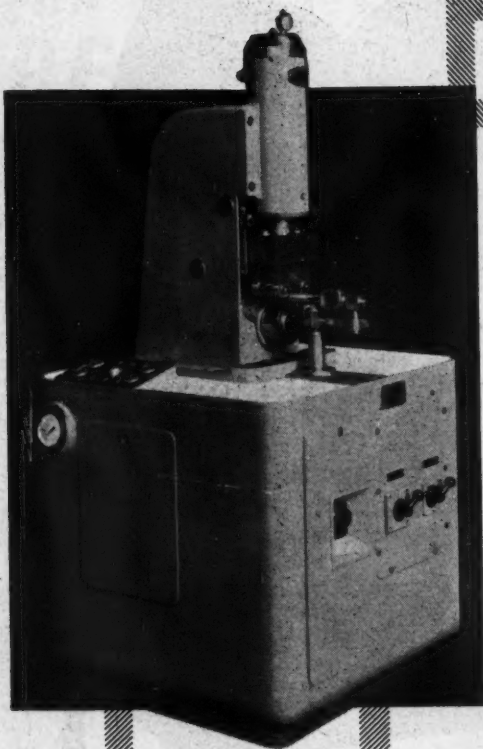
SUPERFINISH ROLL BURNISHING MACHINES

For rapid and economical production of high surface finish.

At one pass of component finish improved from 150 to 5 micro-inches.

Rolled surfaces are harder with increased resistance to wear and fatigue.

Available as semi-automatic and fully automatic machines.



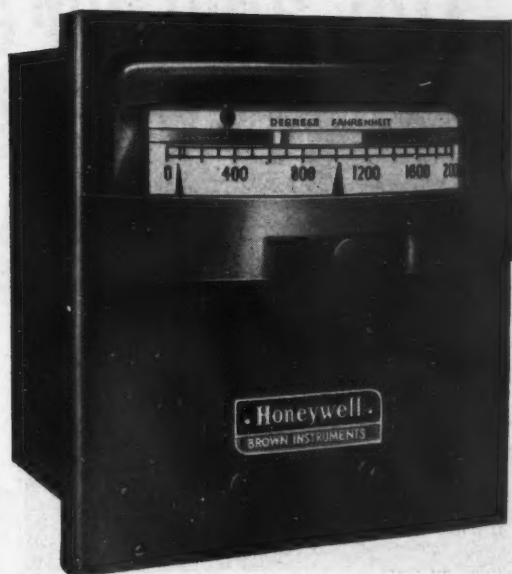
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excels with saturable core reactors

This stepless millivoltmeter proportioning controller is the ideal low cost instrument for use with saturable core reactors. It will control loads of up to 100 KVA, with provision for control of larger reactors. It has a continuous output of 3 to 7 milliamps into an impedance which can be greater than 4,000 ohms. All adjustments are made on the Pyr-O-Volt. The measuring and control units are in one case. A voltage regulator is built-in. Plug-in design and easy accessibility of all Pyr-O-Volt units simplifies servicing.

...and a new indicating millivoltmeter

with top class Honeywell design ·
high quality moving coil movement · plug-in chassis

WRITE OR SEND THE COUPON TODAY to:
Honeywell Controls Limited Greenford Middlesex Wxlow 2333

I am interested in the new additions to your range of millivoltmeters.

Please send me: Pyr-O-Volt Specification Sheet S103-5a.

Indicating Millivoltmeter Specification Sheet S102-1a

(please tick where applicable)

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Company _____

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Address _____

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Sales Offices in the principal towns and cities in the United Kingdom and throughout the world.

M

Honeywell



First in Control
SINCE 1906

When answering advertisements kindly mention **MACHINERY**.

Yet another example of **PRODUCTIVITY!**

KUMMER

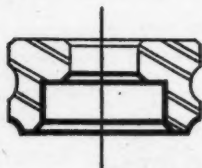
There are many operations where the Kummer K20 can show handsome savings. This is one of many typical examples. Suitable for work on bar, castings, forgings and stampings.

K20 Semi-Automatic Twin-Head PRECISION LATHE...



Operation 1
F.F. 50 secs.

SCALE FULL SIZE



BALL RACE
INNER RING
MATERIAL BEARING
STEEL EN 31

Operation 2
F.F. 50 secs.

SPEED = 500 f.p.m.
FEED = .002in. per. rev.

- Work head spindle can automatically operate at high or low speeds according to preselected cutting speeds.
- Camshaft driven from main spindle.
- Cam accelerator reduces machining cycle time.
- Air-operated chucking.
- Spindle positioning device for irregular shaped components.
- Easy loading of components into chucks.
- Write for full data.

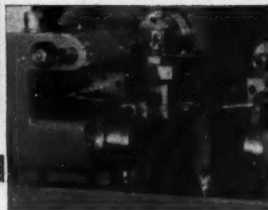


Illustration shows tallstock which is one of the many optional features available.

GASTON E. MARBAIX LTD.

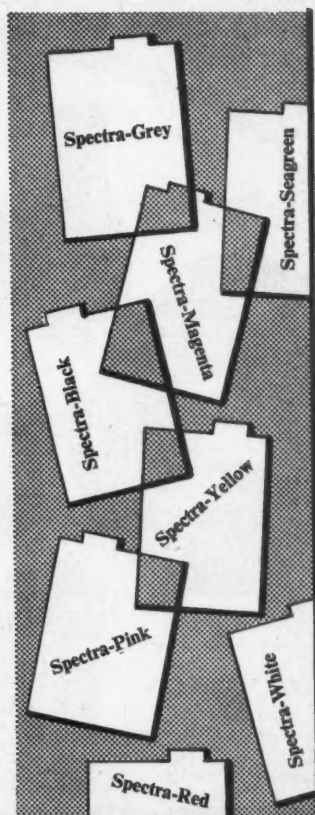
BRUSSELS
FAIR

Visit Stand
No. 2207
Hall 2
and see this
machine

DEVONSHIRE HOUSE, VICARAGE CRESCENT, BATTERSEA, S.W.11. Phone: Battersea 8888 (8 lines)
NRP 3424 A

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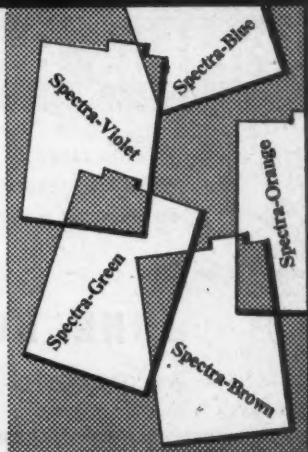
Spectra -Color



*The only layout and identification fluid
in 2 Grades—with each in 13 colours*



In the machine shop, tool room, sheet metal shop and in the stores Spectra-Color provides accuracy, permanence and speed! With Spectra-Color you get needle-sharp layouts which will not smudge, chip, crack or peel, but are there until machined off or removed with Spectra-Remover. Spectra-Color dries instantly in a film only .0002in. thick and is unaffected by oil, petrol or water. In Standard Grade for all bright metals, Opaque for black metals and unmachined castings—both grades in 13 colours!



SPECTRA CHEMICALS LIMITED

Spectra Works, High Street, Caterham, Surrey.
Telephone: Caterham 3182 & 2293

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ACCURATELY MACHINED

QUALITY BRONZE

CASTINGS

- ★ CENTRIFUGALLY CAST
- ★ SHELL CAST
- OR
- ★ CONTINUOUSLY CAST

OUR TECHNICAL
REPRESENTATIVE
WILL BE PLEASED
TO DISCUSS THE
APPLICATION OF THESE
PROCESSES TO YOUR
REQUIREMENTS

*Typical Examples
of our Production . . .*

Holfos Bronze

Regd.

A wide range of engineering components in small and large quantities cast in the HOLFOS foundries in copper-base alloys to standard specifications, precision finished on the most modern machines.

Please write for literature to :—

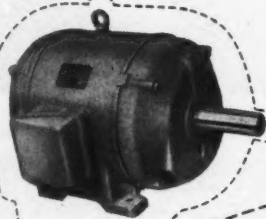
JOHN HOLROYD & COMPANY LIMITED

P.O. Box 24 • Holfos Works • Rochdale • Lancs • Telephone 3155

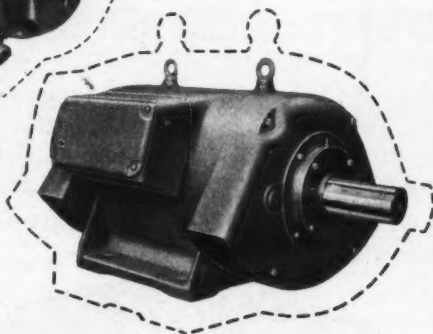
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Compact horse-power with class 'E' insulation

The use of class 'E' insulation—permitting a temperature rise of 65°C—makes these AEI squirrel-cage motors smaller for a given horse-power rating than the conventional class 'A' insulated machines.



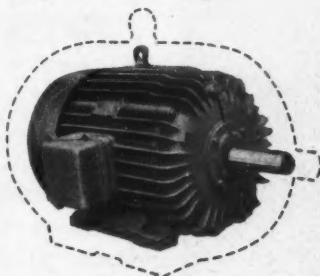
Type KN-C
1 to 75 h.p.



Type NC
80 to 285 h.p.

Drip proof
Squirrel-cage

Totally enclosed,
fan-cooled
Squirrel-cage



Type KN-D 1 to 40 h.p.
Larger TEFC machines available shortly

AEI

Associated Electrical Industries Limited
Motor and Control Gear Division
RUGBY, BIRMINGHAM, & MANCHESTER

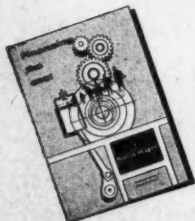
A5561

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a shot in the arm

Perhaps British Wagon can give it. This may be just what your business needs to help it to grow. By using British Wagon's Finance Plan you are able to acquire whatever new plant or machinery you need with only a small capital outlay. You simply buy out of income. Our terms are economical and flexible. For friendly and practical advice on the B.W. Finance Plan, backed by over 90 years' sound financial experience, get in touch with your local branch manager...



... or write for our leaflet 'Financing the Cost'. It gives you full details of how the British Wagon Finance Plan can help you.



Head office: Moorgate, Rotherham, Yorkshire
Tel. Rotherham 5466

Southern Head Office: Rotherham House,
Grosvenor Crescent, London, SW.1 Tel. Belgravia 8000



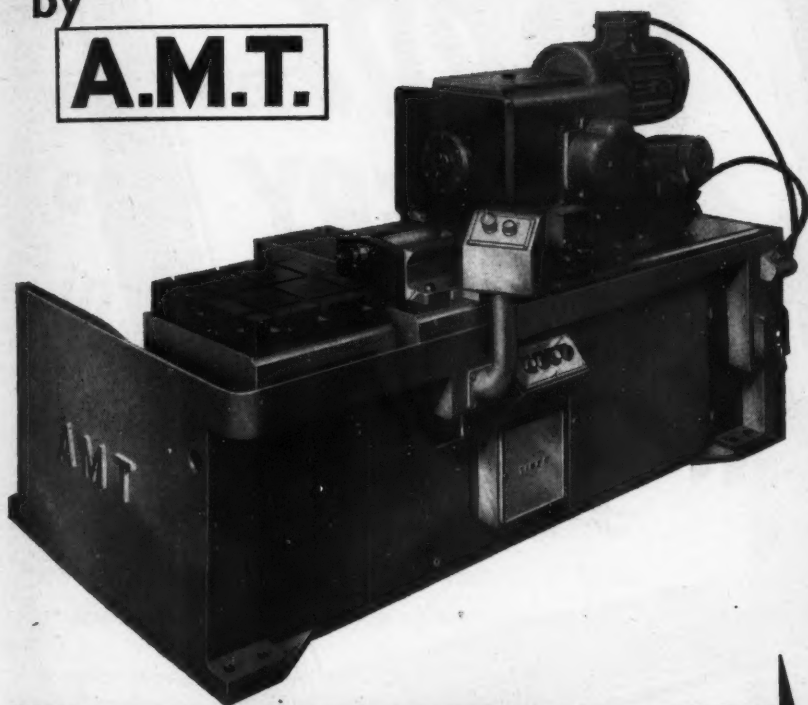
BW/M/84

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THE "MULTI-CYCLE" UNIT MACHINE

by

A.M.T.



with **BUILT-IN SELECTION FOR ALL THESE CYCLES** brings **AUTOMATION** for small or quantity production at unusually low cost

Here is a "multi-cycle" machine within the price range of a single-operation production machine which has been developed especially for batch or quantity production. It is available in three sizes—2 h.p., 5 h.p. and 10 h.p. for horizontal or vertical application.

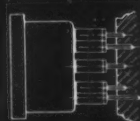
Full details and specification on request.

A·M·T (B'HAM) LTD. Bournbrook, Birmingham 29.

Telephone: SELly Oak 1128/9/20.

Telegrams: "AMTOLD B'ham".

When answering advertisements kindly mention MACHINERY.



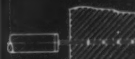
MULTI-SPINDLE
FIXED OR ADJUST-
ABLE CENTRES



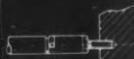
SINGLE SPINDLE
DRILLING ETC



JUMP GAP
DRILLING



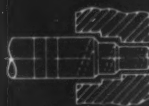
DEEP HOLE
DRILLING
(Woodpecker motion)



TAPPING



SPOT FACING
C. BORING ETC.
WHERE "DWELL"
IS REQ'D



BORING



**240 Pages of opportunities
for you from the most comprehensive
stocks in Britain**

SEND FOR YOUR FREE COPY

To Thos. W. Ward Ltd, Albion Works, Sheffield, England.
Please send me a current copy of the Albion Machinery Catalogue.

NAME _____
FIRM _____
ADDRESS _____

53

THOS. W. WARD LTD

ALBION WORKS • SHEFFIELD

TELEPHONE:- 26311 (22 LINES).

TELEGRAMS:- "FORWARD SHEFFIELD"

LONDON OFFICE:- BRETTENHAM HOUSE, LANCASTER PLACE, STRAND, W.C.2. Phone. TEM 1313

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July

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July 26, 1961

MACHINERY

**What
ARE**

***all these
cuts
in cost?***

THE STEEL ITSELF

Higher working stresses have recently been sanctioned; why? Because the strength and dependability of British structural steel have attained such a high level.

In other words, the steel is so strong that for a given job you can safely use less of it ... LESS STEEL ... LESS HANDLING ... LOWER COST.

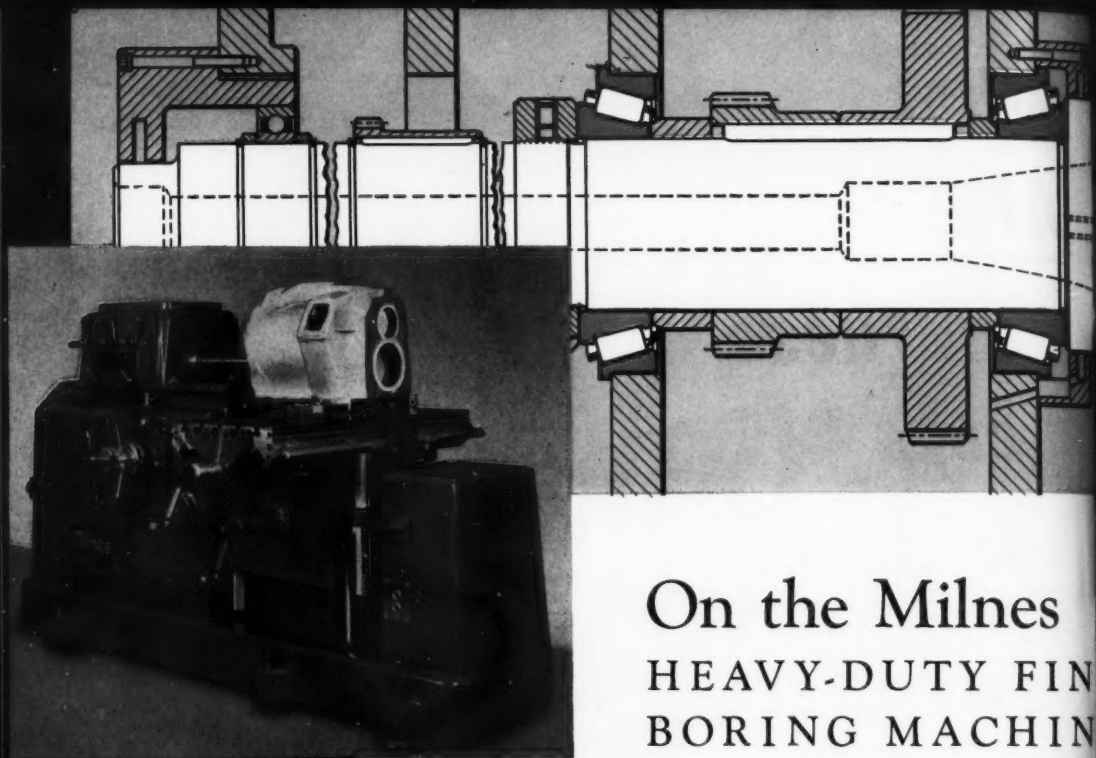
This is the first of a series clarifying the recent cuts in cost of steelwork.

BRITISH CONSTRUCTIONAL STEELWORK ASSOCIATION,
ARTILLERY ROW, WESTMINSTER, S.W.1

B.C.S.A

STEELWORK





On the Milnes HEAVY-DUTY FINISHING BORING MACHINE

BEARINGS OF GREAT ACCURACY

Fitted with high-precision 'double-zero' Timken bearings, the machine has exceptional accuracy.

Tests show how well it combines the qualities of heavy-duty and high precision: it will take roughing cuts up to $\frac{1}{2}$ " deep, and produce work to a roundness of less than 'a tenth'—

$$\frac{8}{100,000}$$

This is a convincing demonstration of the value of high-precision Timken bearings, not only in their own internal accuracy but also in the way their flanged cups facilitate accurate machining of the headstock.

British Timken, Duston, Northampton, Division of The Timken Roller Bearing Company. Timken bearings manufactured in England, Australia, Brazil, Canada, France and U.S.A.



TIMKEN®
REGISTERED TRADE-MARK
tapered roller bearings

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IN
IN
ACV
ngs, t
duty
deep,
precis
racy b
machin
Timb
tured



Among the most prized possessions
of resourceful engineers—**QUALCUT TOOLS**

QUALCUT TOOLS LIMITED, HANDSWORTH RD., SHEFFIELD 13. TEL: SHEFFIELD 49371/6

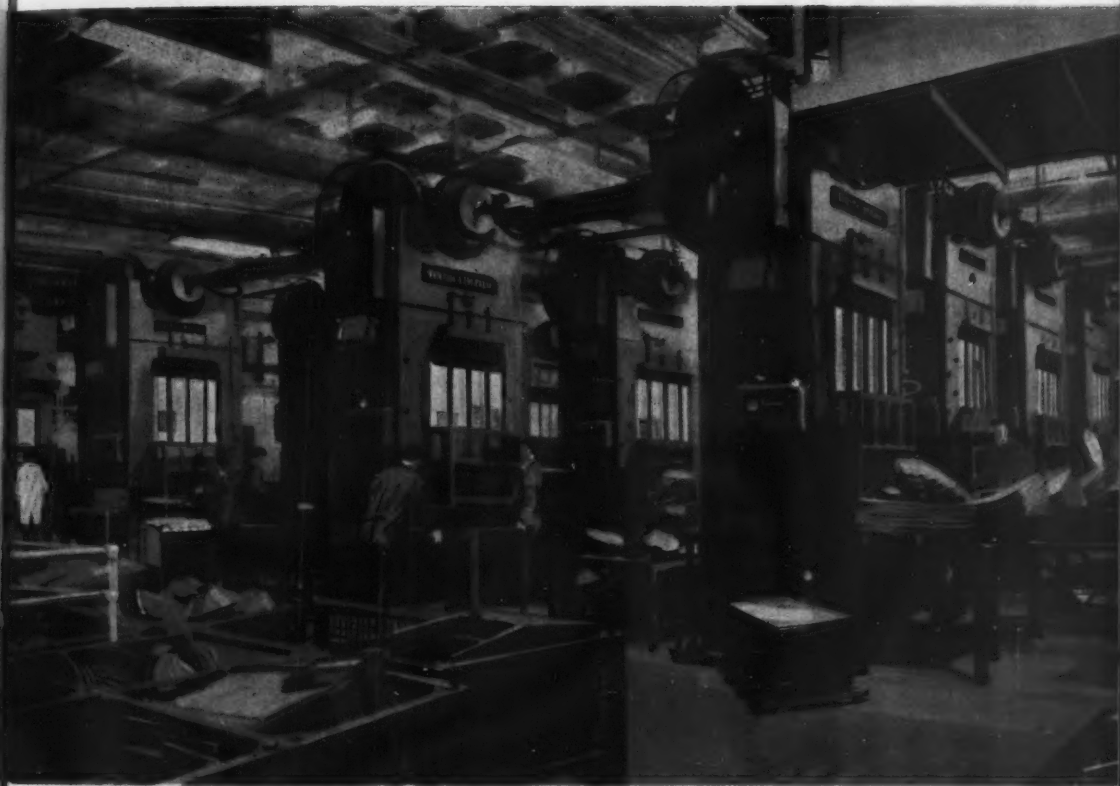
PRESSING FOR PRODUCTION . . .



The pressing assembly as produced by HOOVER Ltd for their KEYMATIC Washing Machine in their Merthyr Tydfil Press Shop illustrated on the opposite page.

THE APPLIANCE FIELD

The preference of so many of the busiest manufacturers in the appliance industries for Wilkins & Mitchell Power Presses, especially in their most recent installations, is based on their need for higher productivity. Throughout the world, users have learned to rely on the design, dependability and built-in reserves of Wilkins & Mitchell Presses .. the complete press shop .. or the single press. Why not consult us on your press requirements?



WILKINS & MITCHELL PRESSES (150 to 350 tons—36" to 108" between uprights) at work on HOOVERS latest washers,

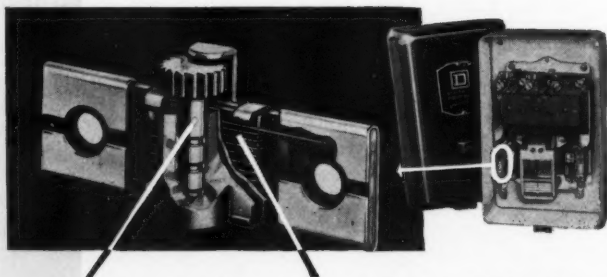
WILKINS & MITCHELL

The Presses that cut costs

WILKINS & MITCHELL LTD . DARLASTON . S. STAFFS . ENGLAND

When you buy Motor Starters - - **YOU PAY FOR OVERLOAD PROTECTION**

...BE SURE YOU GET IT!



Heat responsive element
(solder pot) provides accurate response to overload, yet prevents nuisance tripping.

Heat producing element is an integral part of overload unit. It's permanently joined to solder pot, can't become misaligned.

Only ONE-PIECE Overload Relays can give 100% Protection. Only with ONE-PIECE construction can you *know* you've installed the heater correctly. Only with ONE-PIECE construction can you *know* the heater is exactly centred, or properly positioned, so that it performs according to its rating. Only with ONE-PIECE construction can you *know* your starters will not operate without the thermal units properly installed. Only with ONE-PIECE construction can you *know* your motors have full protection.

Only Square D has ONE-PIECE Construction. ONE-PIECE construction eliminates any possibility of heater misalignment. Square D melting alloy thermal overload relays can be installed only one way. They are tamper-proof. They are factory-assembled, are individually calibrated and tested. Repeated tripping will not affect their accuracy. **Insist on Square D starters with melting alloy thermal overload relays.**



Let your Square D Field Engineer show you (1) how one-piece construction is accomplished and how easy it is to mismatch separate heaters and solder pots—(2) a tripping time tester to compare various types of melting alloy units and to prove that tripping time won't change after repeated operation.



Individual factory inspection of every Square D melting alloy thermal overload relay means performance you can trust. Each unit is calibrated and thoroughly tested to make sure it will perform according to its rating.

Leaders in Control Gear for over 50 years.



SQUARE D LIMITED

CHENEY MANOR SWINDON WILTSHIRE

Square D products are stocked by leading electrical wholesalers throughout Great Britain.

FIELD OFFICES — LONDON • BIRMINGHAM • MANCHESTER • GLASGOW • NEWCASTLE • BRISTOL • LEEDS



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5, 1961

"CAPITAL" HIGH SPEED STEEL TWIST DRILLS



STEEL & TOOLS

ARTHUR BALFOUR

FOR THE WORLD

ARTHUR BALFOUR & CO LTD. CAPITAL STEEL WORKS, SHEFFIELD ENGLAND.
ASSOCIATED COMPANY: THE EAGLE & GLOBE STEEL CO, LTD.

See us at STAND NO. 3212 HALL NO. 3,
7th EUROPEAN MACHINE TOOL EXHIBITION, BRUSSELS from SEPT; 3rd - 12th.

Lockheed

for

HYDRAULIC VALVES

We market a wide range of valves to meet the requirements of hydraulic systems.

Our range of units is designed for working pressures up to 3,000 p.s.i. and is generally suitable for fluid flows up to 30 g.p.m. but some units are of larger capacity.

We shall be pleased to quote you for your hydraulic valve requirements or alternatively to engineer and supply complete hydraulic systems.

Our hydraulic installations carry twelve months free service.

Pamphlets of Lockheed valves on application.

LOCKHEED PRECISION PRODUCTS LIMITED
INDUSTRIAL HYDRAULICS DIVISION
 SHAW ROAD, SPEKE, LIVERPOOL 24
 Hunts Cross 2121 Telex 62394

There are Industrial Hydraulic Sales Engineers at your service also at

AUTOMOTIVE HOUSE
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 Leamington 2700 Telex 31549

144 ST. VINCENT STREET, GLASGOW C.2
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Lockheed

INDUSTRIAL HYDRAULICS

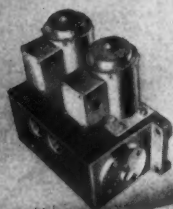


(ONE OF THE
 AUTOMOTIVE
 PRODUCTS
 GROUP)

REGD.
 TRADE
 MARK
 LOCKHEED

BRITISH
 MADE

LOCKHEED SOLENOID OPERATED 4-WAY VALVE



PARTICULARS IN BRIEF
 Suitable for flows up to 30 g.p.m.
 Integral twin solenoid coils
 Pilot valves
 D.C. Solenoids up to 240 v.
 Rectifiers for A.C. supplies
 Main valve plunger spring-
 loaded or with two position
 location
 For fluid pressures up to 3,000 p.s.i.
 Pressure-button overriding
 optional

DOUBLE RESTRICTOR VALVE
 FOR INDEPENDENT TWO-WAY FLOW REGULATION



PARTICULARS IN BRIEF
 Adjustment of flow in each direction
 independently
 Suitable for flows up to 10 g.p.m. and
 pressures up to 3,000 p.s.i.
 Design tapped 1/2 B.S.P. or 1/4 B.S.P.

DESCRIPTION

The restriction of the flow in one or
 both directions is achieved by means of
 a ball valve mechanism.

Lockheed
HYDROLOC VALVE
 (TO GIVE HYDRAULIC LOCKING)



PRESSURE REDUCING VALVE

PARTICULARS IN BRIEF

Rated flow capacity up to
 10 g.p.m.
 For inlet pressures up to
 3,000 p.s.i.
 Output (reduced) pressure
 down to 50 p.s.i.
 Available for pipe or flange
 mounting.
 Main outlet tapped 1/2 B.S.P.

1 1/2 B.S.P. CONTROL VALVES



METERING AND REVERSING VALVE
 INCORPORATING PILOT SWITCH



PILOT CUT-OUT VALVE

PARTICULARS IN BRIEF
 1/2 B.S.P. Control Valve Unloader.
 1/2 B.S.P. Relief Valve Unloader.

each available for—
 Working Pressure—Cut-out 1700-400 p.s.i.
 High Pressure—Cut-out 2000-1000 p.s.i.
 Between outlet and cut-out adjustable
 p.s.i. and 200-600 p.s.i. respectively

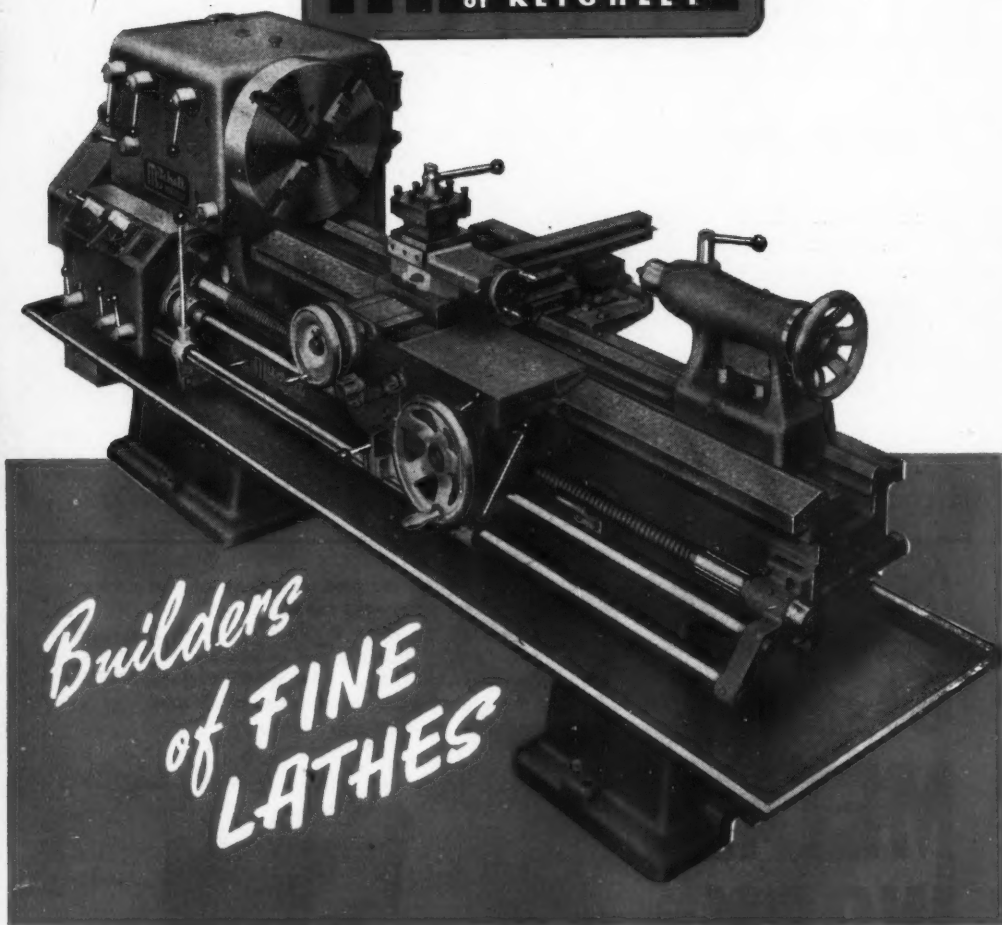


NEEDLE VALVE

LOCKHEED NEEDLE VALVE



often absolutely essential in a hydraulic
 system of hydraulic controls and
 of importance controlling
 the pressure and flow of
 the fluid and preventing
 backflow.



*Builders
of FINE
LATHES*

FROM 6 $\frac{1}{2}$ " TO 16 $\frac{1}{2}$ " HEIGHT OF CENTRES

These machines are built out of a long tradition of craftsmanship to the highest modern standard of design, productive capacity and precision. There are sizes and types to meet your own needs. Ask us to send you details.

MANUFACTURERS: D. MITCHELL & CO. LTD., KEIGHLEY, YORKS
Telephone: Keighley 4283

London and Export Office:

MORRISON, MARSHALL & HILL LTD., TOWER HILL, LONDON, E.C.3
Tel: Royal 1461 Cables: Morimil, London Grams: Morimil, Fen London

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HAYCOCK

STANDARD & SPECIAL

also

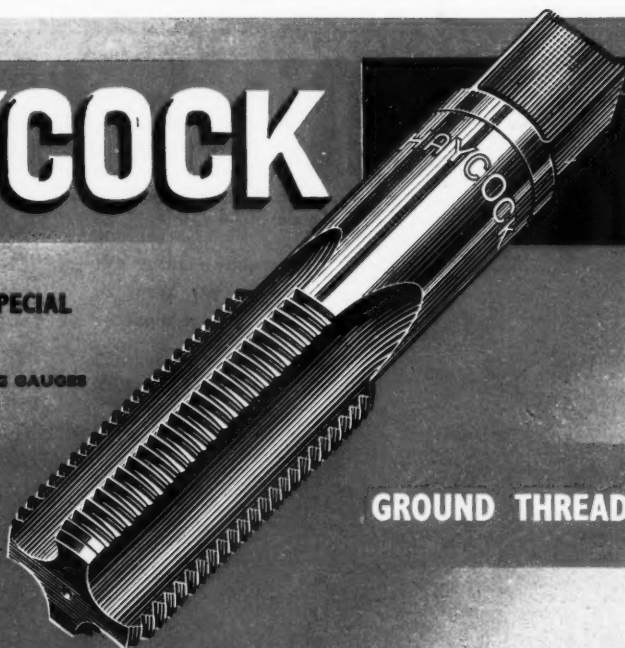
SCREW PLUG & RING GAUGES

FORM TOOLS

JIGS & FIXTURES

PRESS TOOLS

SPECIAL PURPOSE
EQUIPMENT



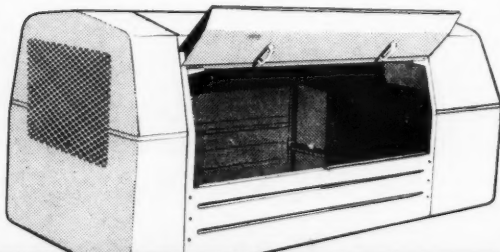
experience counts.

GROUND THREAD TAPS

HAYCOCK GAUGE & TOOL CO. LTD, Brays Lane, Coventry, England. Telephone 53368 (3 lines)

INDUSTRIAL SHEET METAL WORK

Dimensional accuracy and good, clean finish can save you a great deal of time and money—and you can rely on Cornercroft workmanship. We're particularly well-equipped, too, with argon-arc, seam and spot welding plant, spinning and press shops, toolroom, process and finishing shop, etc., and produce structures and components of any size, in any quantity. Can we help you?



—by—

CORNERCROFT

Cornercroft, Ltd. (The Cornercroft Group of Companies),
Ace Works, Parkside, Coventry. Phone 23391.

NC356

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July 2

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Prolite SCRAPERS

will speed the job . . .

'PROLITE' INSERTED
BLADE SCRAPERS save
both time and money, because
they require less servicing.
Each holder will accommodate
blades 1 in. or 1½ in. wide.
Holder and blades can be
supplied ex stock.

Engineers are always available
to discuss this and other appli-
cations of 'Prolite' or to demonstrate
'Prolite' tools in your works.

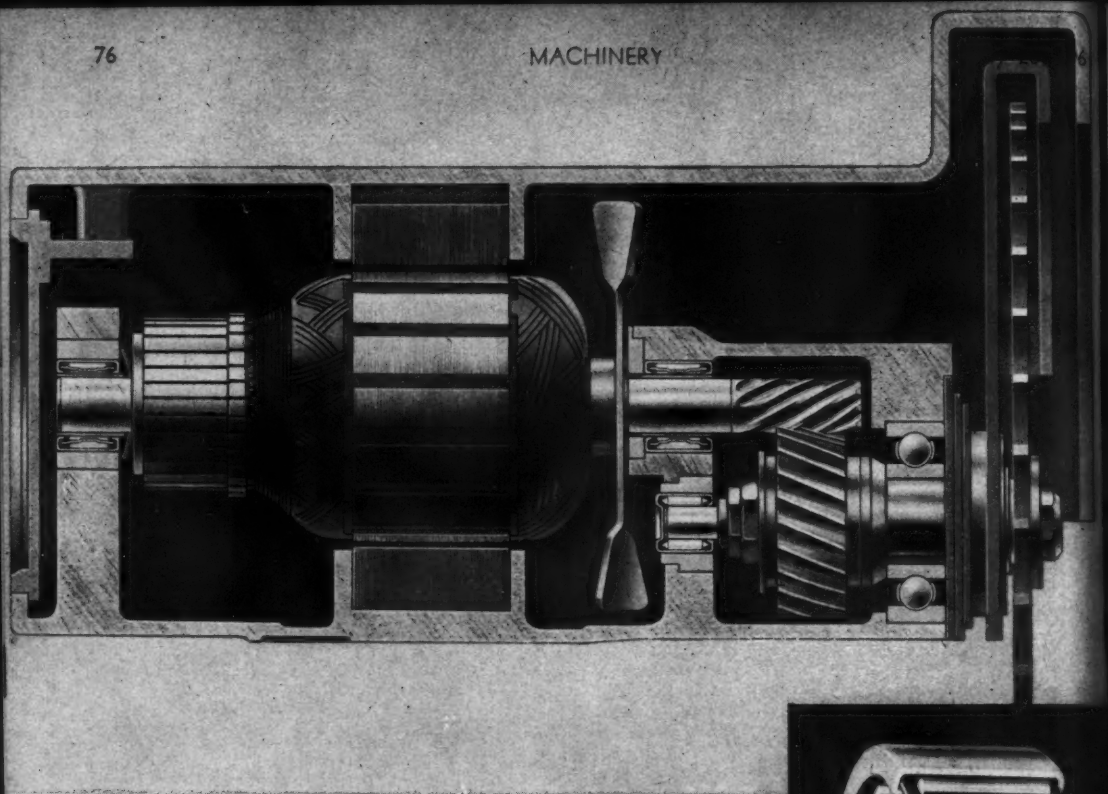


Prolite CEMENTED TUNGSTEN CARBIDE

Home Sales: **PROTOLITE LIMITED** (a subsidiary company of Murex Ltd.), RAINHAM, ESSEX.
Telephone: Rainham Essex 3322. Telex: 28632. Telegrams: Prolite, Rainham-Dagenham Telex.
Southern Area Office: Central House, Upper Woburn Place, London, W.C.1.
Midland Area Office: Guildhall Buildings, Navigation Street, Birmingham 2.
Northern Area Office: Norwich Union Buildings, City Square, Leeds 1.

Export Sales: **MUREX LIMITED** (Powder Metallurgy Division), RAINHAM, ESSEX, ENGLAND.
Telephone: Rainham, Essex 3322. Telex: 28632. Telegrams: Murex, Rainham-Dagenham Telex.

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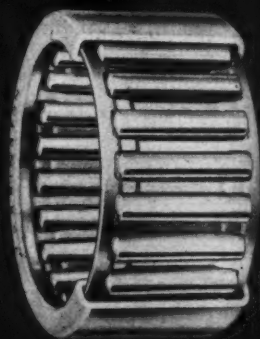


Performance plus for armatures with Torrington Drawn Cup Roller Bearings

Armatures of many portable power tools are now equipped with Torrington Drawn Cup Roller Bearings, which provide high speed operation and long pre-greased life at low cost. Offering compactness, light weight, easy installation, smooth starting and cool running, the Drawn Cup Roller Bearing can be economically designed into portable drills, saws, mixers, vacuum cleaners, automotive generators and alternators and many other applications.

THE TORRINGTON COMPANY LTD

Bearings Division: TORRINGTON AVENUE, COVENTRY
LONDON AND EXPORT OFFICE: 7-10 ELDON STREET, EC2
GLASGOW OFFICE: 50 WELLINGTON STREET, C2



**Armature-mounted
Torrington Drawn Cup
Roller Bearings
offer these advantages:**

*High capacity in
small cross section*

*Long pre-greased
service life*

*Outstanding efficiency
at high speeds*

Easy mounting by press fit

Low unit cost

TORRINGTON BEARINGS

*The
Gecin^{us} Viridis
is*

Efficient

But hardly a

Illustrated right is the latest
RICHARDS Table type
Horizontal Boring, Facing,
Milling, Drilling and
Tapping machine, built in a
range with Traversing Spindle
diameters 2½ in. to 8 in.

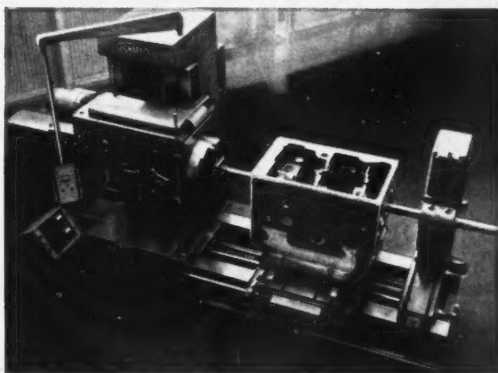
RICHARDS

STAVELLEY **SG** GROUP



PRECISION BORER

HORIZONTAL and VERTICAL BORERS produced by GEORGE RICHARDS & CO. LTD., however are unsurpassed for precision, speed and adaptability. Continuous research and development keep RICHARDS borers way ahead of all others.



GEORGE RICHARDS & CO. LTD.
BROADHEATH - ALTRINCHAM - CHESHIRE

Sole Agents: ALFRED HERBERT LTD., FACTORED DIVISION, COVENTRY. TAYSON R502

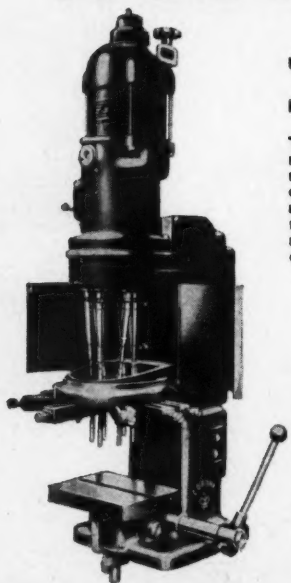
When answering advertisements kindly mention MACHINERY.

CUT your drilling costs



CORONA

Adjustable Spindle MULTIPLES

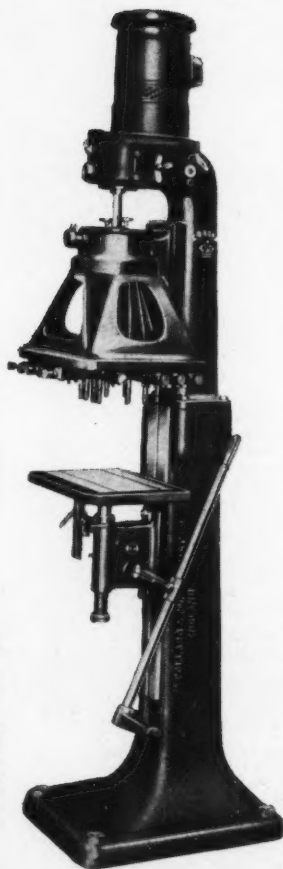


TYPE 12 MX
UP TO 12 SPINDLES IN AN AREA
OF 12in. — 8in.
MAXIMUM DRILLING CAPACITY
8in.

These machines keep costs low on multiple repetition drilling. Any number of spindles up to 12 can be employed and adjustment is rapid and simple. Feed is by lever and rack-operated table with a vertical adjustment of 20in. Available with electrical reverse.

TYPE 6 MX
BENCH OR PEDESTAL
UP TO 10 SPINDLES IN AN AREA
OF 5in. DIA.
MAXIMUM DRILLING CAPACITY
0.196in.

Available with or without electrical reverse, these machines will drill and tap small components at very fast rates. Tee-slotted table has lever feed. Head has 6in. vertical adjustment. Two speed ranges through gear box. Maximum speed 3,000 r.p.m.



FREDK POLLARD & CO LTD

CORONA WORKS, LEICESTER, ENGLAND. • TEL: LEICESTER 67534 (5 lines)

London Office: COASTAL CHAMBERS, 15 ELIZABETH ST., BUCKINGHAM PALACE RD., S.W.1. TEL: SLOANE 8800

Scottish Representatives: WALTER S. LANG & CO., 48 OSWALD STREET, GLASGOW, C.I. TEL: CENTRAL 2539

North East: HODSON MACHINE TOOLS LTD., 150 NEW BRIDGE STREET, NEWCASTLE-UPON-TYNE

When answering advertisements kindly mention MACHINERY.

*If you want to know something about
BORING & TURNING MILLS...*




If your business requires the boring and turning of medium to large castings and forgings or similar components, and you do not use Webster and Bennett Boring Mills, it's highly probable your competitors do.

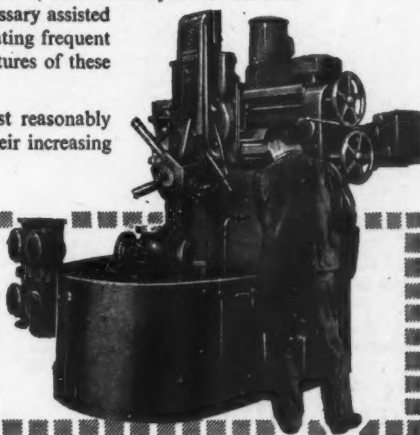
In that case, they'll be getting the benefit of lower overheads, because on the bases of capital costs and running costs there are no other machines quite as economical.

Powered for carbide tooling and high metal removal rates; centralised hydraulic controls for operating convenience; easy reservicing when necessary assisted by unit construction; self-compensating clutches obviating frequent adjustment for wear, are some of the outstanding features of these machines.

Add to this the fact that they are probably the most reasonably priced machines of their kind, and the reasons for their increasing demand become clear.



The illustration shows one of the battery of Webster and Bennett Boring Mills installed in the London Works of Dewrance & Co. Ltd., facing, turning, boring and screwing 5" valve bodies in a floor to floor time of 66 minutes.

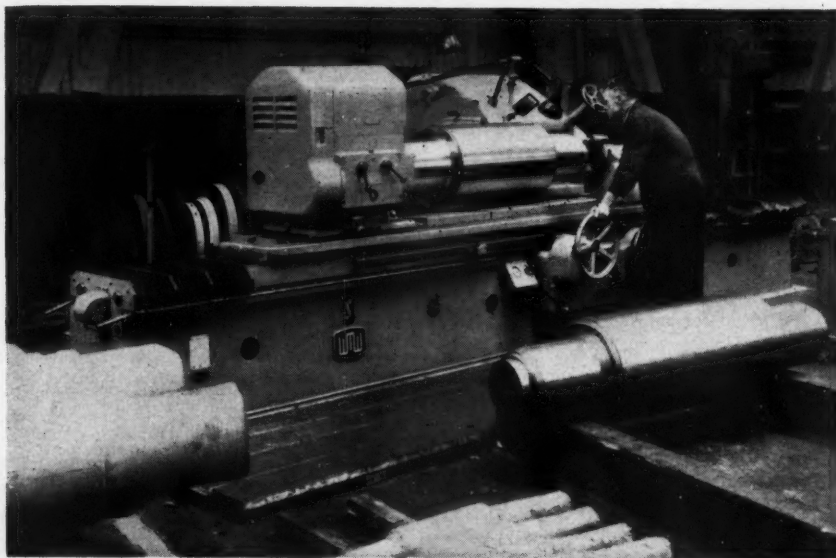


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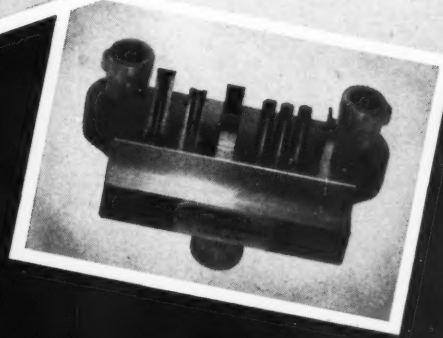
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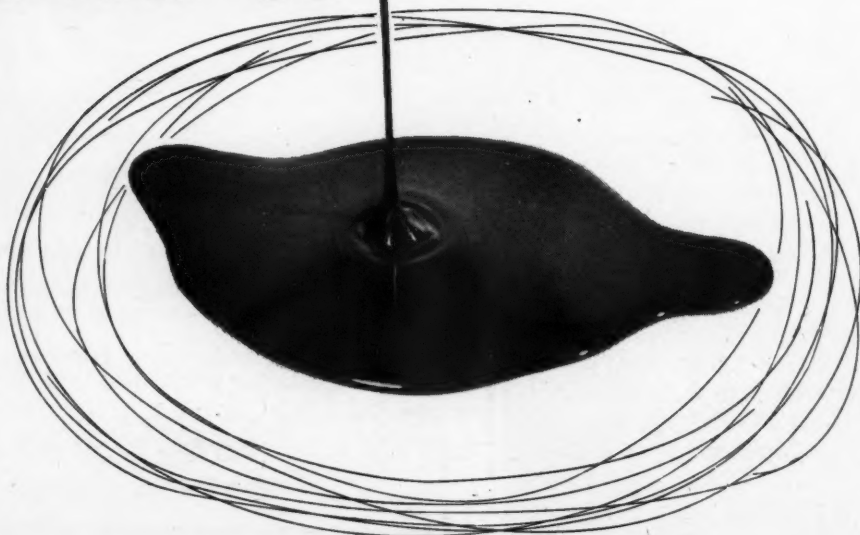
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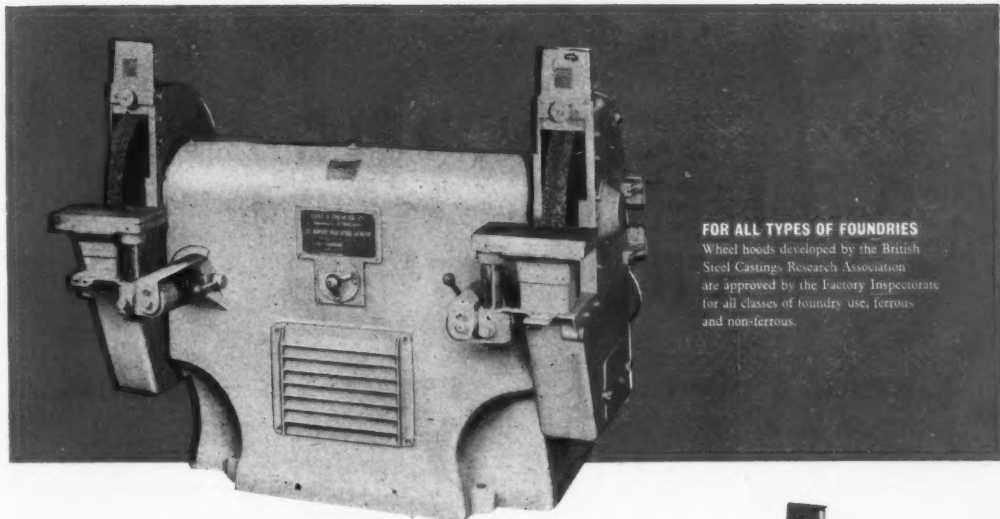
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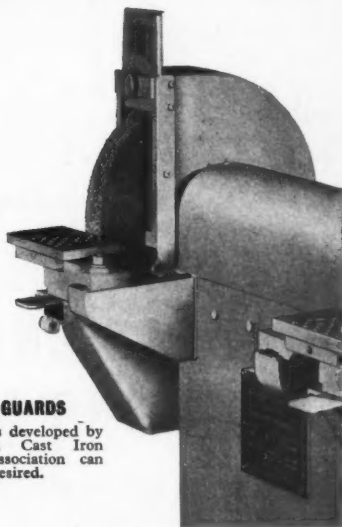
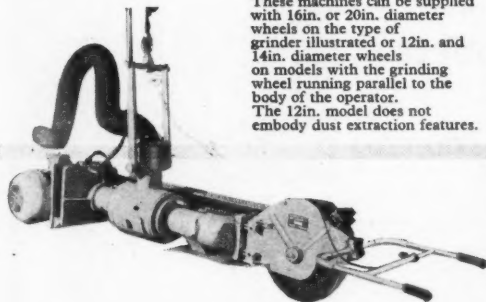
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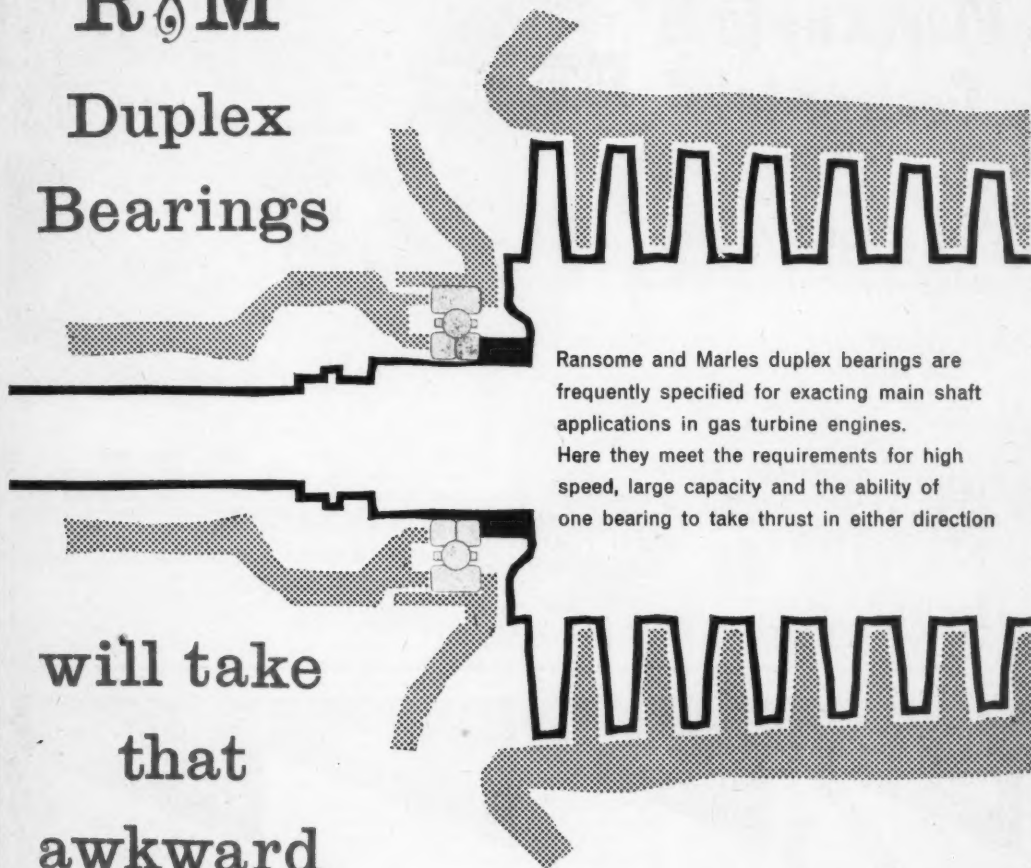
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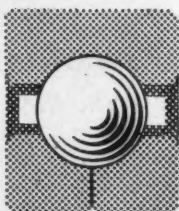
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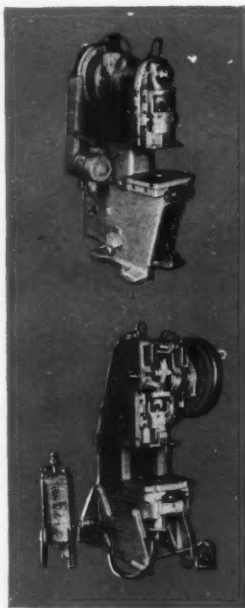
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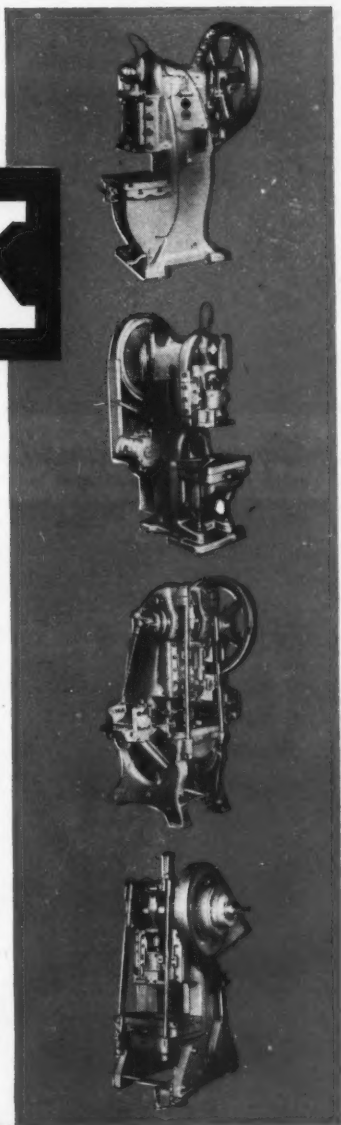
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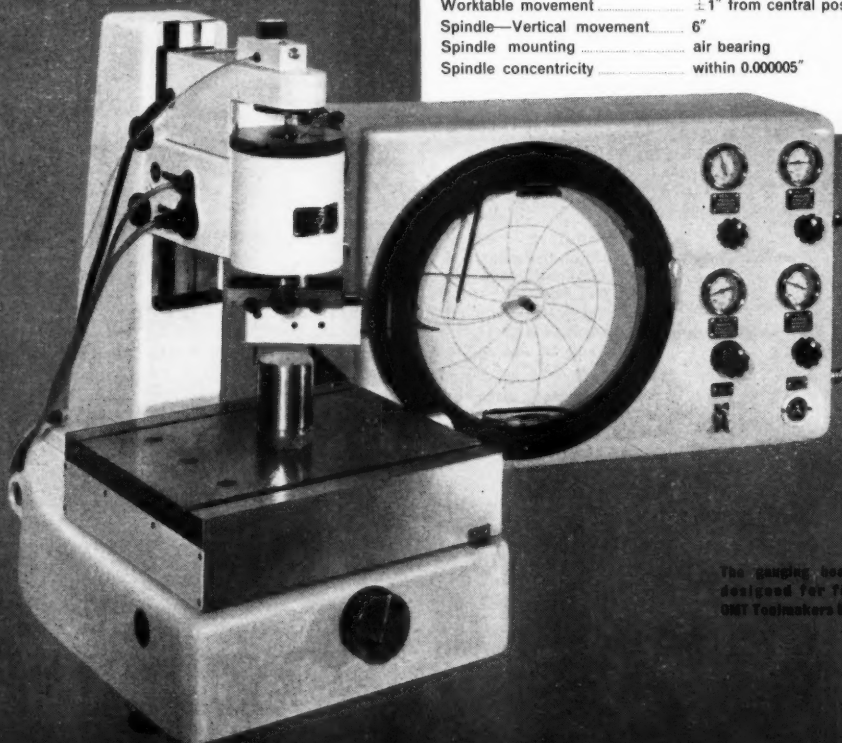
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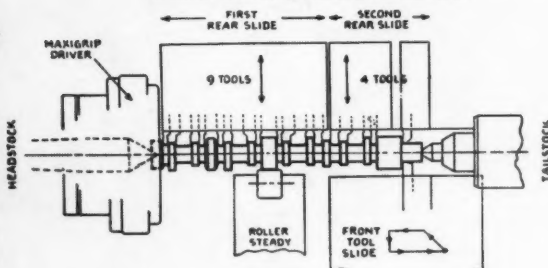
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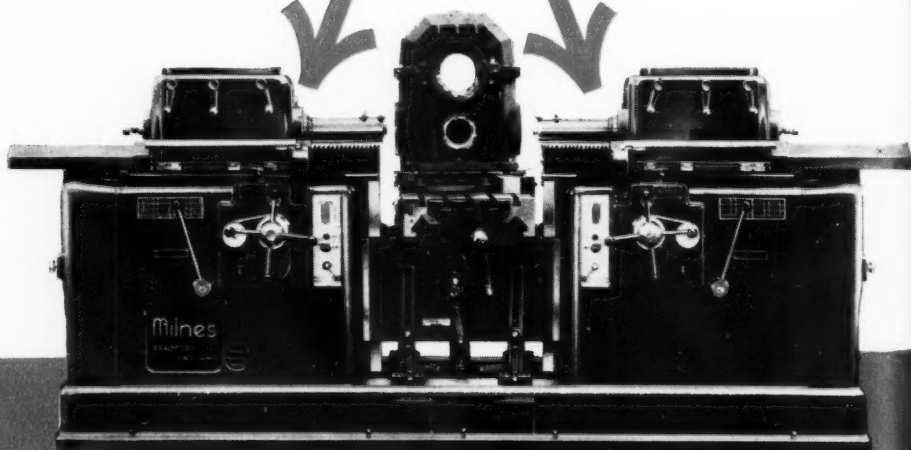
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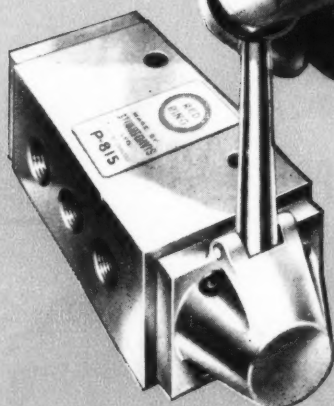
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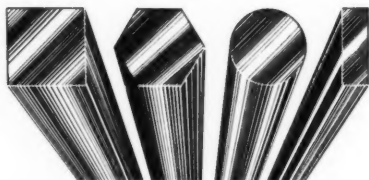
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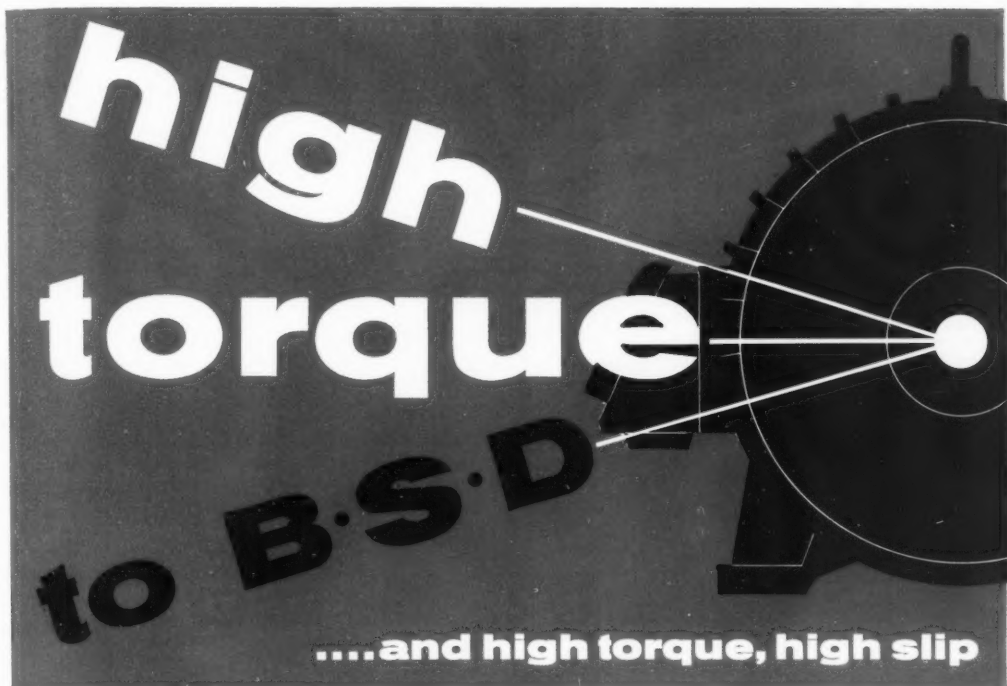
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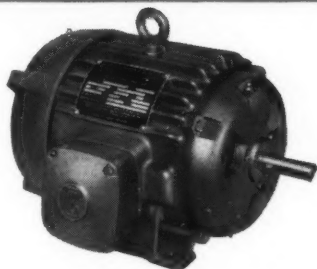
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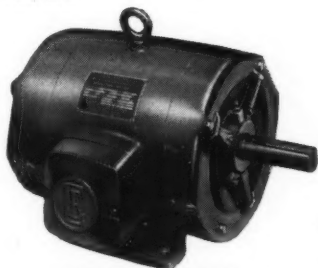
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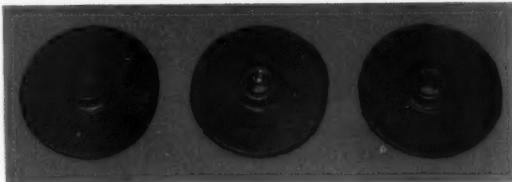
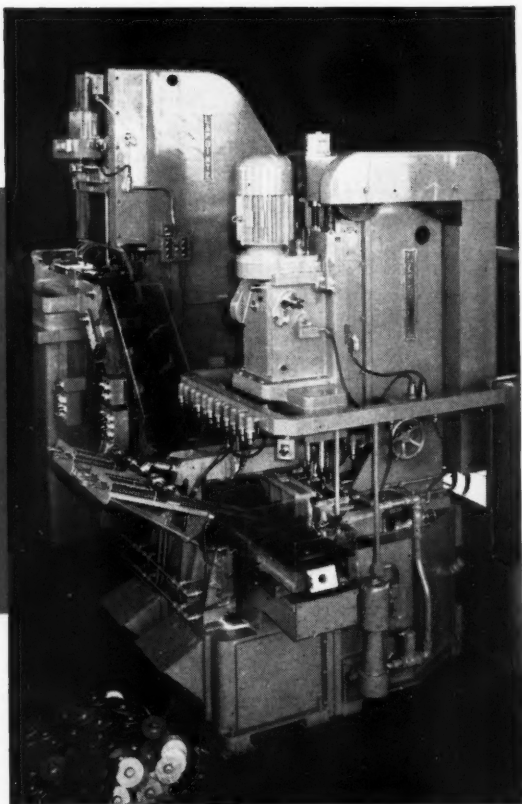
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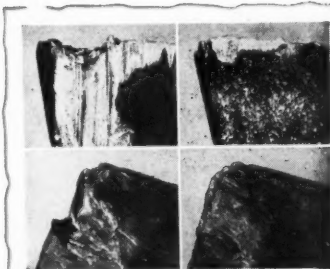
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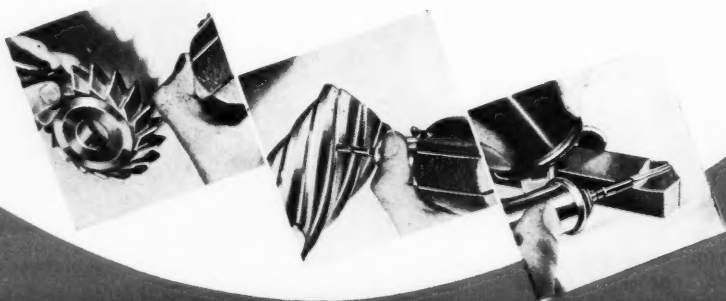
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A JOURNAL OF METAL-WORKING PRACTICE & MACHINE TOOLS

Vol. 99, No. 2541

July 26, 1961



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Abstracts of Principal Articles

The Production of Hydraulic Pit-props P. 180

In this second article, concerned with some of the methods employed by Dowty Mining Equipment, Ltd., Ashchurch, Glos., for producing their Mark IV Duke hydraulic pit-props, further examples of operations performed in the preliminary fabrication section are discussed. These operations include the swaging of the outer tubes, on a special-purpose Dowty hydraulic machine, and the arc welding of the pump cylinders to the piston heads. The methods and equipment employed in a special department devoted to the assembly and testing of breather valves and relief valves are also considered. (MACHINERY, 99—26/7/61.)

The Mechanics of Chip Formation.. P. 193

This article is an abstract of a paper read before the American Society of Mechanical Engineers and includes some of the results of experiments which were carried out in investigation of the mechanics of metal-cutting with the aid of a new technique. The equipment employed includes a high-speed cine camera which provides for rapidly recording various data while cutting is taking place. This data is subsequently analyzed. The experiments were carried out on a shaping machine, on which the conventional procedure was "reversed," that is, the tool was mounted on the work-table and the workpiece was secured rigidly to the reciprocating ram. Various materials were machined, including cold rolled steel, hot rolled steel, wax, brass and aluminium, and valuable data was obtained in connection with deformation of the work in advance of the cutting edge, the growth of cracks in the work, and the build-up of material at the tool face. The high-speed film revealed that the tool face and chip flow bear some resemblance to the bow of a ship ploughing through water, and it is suggested that an analogy with hydrodynamic flow may be plausible. (MACHINERY, 99—26/7/61.)

The East German Institute of Machine Tool Engineering P. 202

After a brief reference to the organization of the East German machine tool industry, and the scale of output, this article gives some details of the Institute of Machine Tool Engineering, and the work undertaken. This Institute has recently occupied a

new building which includes a large test hall with facilities for studying problems likely to arise in connection with the designing and construction of machine tools. The hall has a number of vibration-insulated concrete rafts on which machine tools can be installed for testing, and an extensive range of equipment is provided. Examples of work in progress include the testing of a fine-boring machine, measurement of the stiffness of a guillotine frame with strain gauges, and investigation of the effects of vibration in hydraulic oil on a broaching machine. The influence of the Institute on machine tool design is also discussed. (MACHINERY, 99—26/7/61.)

The Gating of Aluminium Die Castings P. 209

The gating of aluminium alloy die castings determines, more than any other factor of die design, the surface finish and structural soundness which is obtained. A primary aim of gating practice must be to avoid sealing-off vents and overflows in the early stages of filling, since once this has occurred residual air is inevitably trapped within the casting. Gating arrangements which produce this effect are considered, as are the disadvantages caused by curved runners. For aluminium castings, thin section gates should be avoided, and heavier gates, which result in "puddling" of the incoming metal, provide various advantages. Mention is also made of the effects of ribs, and their positions, on the flow of metal in a die. Finally, mention is made of the increasing use of milling techniques to remove runners from castings. (MACHINERY, 99—26/7/61.)

Machine Tools at the Soviet Exhibition P. 217

The second of two, this article describes machine tools on show at the Soviet Exhibition, including a fine boring machine with programme control by punched cards, and a hydraulically-operated indexing fixture. A large 8-spindle, vertical chucking automatic has punched card control of feeds for the individual tool slides. Automatic control of the down-feed is provided on a horizontal-spindle surface grinding machine, and the design of a universal thread-grinder makes it possible to carry out external, internal and taper thread grinding, in addition to form-relief work. A grinding machine for straight and helical spur gears operates on the generating principle. (MACHINERY, 99—26/7/61.)

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

EDITORIAL

Progress in Precision

Further advances in many branches of engineering and in other scientific fields will depend to a large extent on the ability to produce components and to measure them with a constantly increasing degree of accuracy. Very important progress has been made in these directions during recent years and with progressive refinements in techniques of measurement and comparison, the form of the ultimate standard to which all dimensions must be related has assumed greater significance. Obviously, in view of the multiplication of errors that inevitably occurs at the various stages necessarily involved in the comparison of the workpiece dimension in the machine shop or the inspection room with the ultimate standard, it is most desirable that the latter should not itself be subject even to minute changes. Partly for this reason, a satisfactory alternative to the material standards of length that have served hitherto has long been sought. As is well known, much work has been done over a long period of years to determine the feasibility of employing a wavelength of light for this purpose, and for the metre such a definition was adopted last year. As a result, the metre is now defined by means of "the radiation that corresponds to the transition between the levels $2p_{10}$ and $5d_5$ of the atom of krypton 86 and by agreement is equal to 1,650,763.73 times the wavelength of this radiation."

This natural standard is indestructible, can be reproduced in laboratories in any part of the world, and is of assured stability. It is stated, moreover, that its adoption has resulted in an important gain in precision, since the degree of uncertainty has been reduced in the ratio of at least 10:1. To enable the potential advantages of the new standard to be implemented, special equipment has been designed and constructed by a company of world reputation in the field of metrology of the highest precision, in collaboration with the International Bureau of Weights and Measures.

This equipment, which it is hoped to describe in some detail in a future issue of *MACHINERY*, will be installed and operated under conditions that will permit the meticulous measurement and control of environmental conditions so essential if the desired degree of precision is to be achieved. Thus, the equipment will be enclosed when in operation in an airtight cylinder within a room, and it is hoped to control the temperature in the room to 0.01 deg. C. and in the cylinder to 0.001

deg. C. In view of their influence on the wavelength of the light source, moreover, there will also be provision for very accurate determination and regulation of such factors as the humidity, pressure, and composition of the air within the cylinder.

Where such refinements of measurement are sought, it is obviously essential to ensure that the results are not affected by the proximity of the operator and that the minimum of reliance is placed on his senses for purposes of adjustment and observation. For these reasons, the operator will be housed in an adjacent room which will be heavily insulated and an elaborate system of remote control and indication is provided to ensure, as far as possible, that readings obtained will be independent of his judgment. The sensitivity of the equipment is greatly enhanced by the use of photo-electric—rather than optical—microscopes, which enable a scale line to be located within only minute limits of error, or the displacement of such a line from the microscope axis to be determined with great precision. It is understood, moreover, that provision has also been made for counting interference fringes photo-electrically when measurements are being made by interferometry, to eliminate another source of human error. In this connection it has been stated that it will be possible to obtain readings to 0.01 of a fringe, and mention has even been made of 0.001 of a fringe. To enable the sensitivity implied to be better appreciated, it may be pointed out that 0.01 of a fringe represents a distance of approximately 0.24 micro inches.

Of especial interest to the engineer concerned with the design and production of high precision machines and mechanisms are certain of the mechanical problems that have been encountered in connection with the construction of the equipment, and the manner in which they have been solved. Thus, to obtain very sensitive movement of a slide for final positioning, magnetostriction of a nickel bar is employed, the amount of the magnetizing current applied being under the control of the operator. In another part of the equipment it was necessary to provide for very accurate angular adjustment of a compensating plate for the purpose of varying the light path when taking measurements by interferometry. With the mechanism employed, the torques exerted

(Continued on page 231)

The Production of Hydraulic Pit-props

Methods Employed by Dowty Mining Equipment, Ltd., Ashchurch, Glos.

By S. C. POULSEN, Associate Editor

AN EARLIER ARTICLE IN MACHINERY, 99/82—12/7/61, was concerned with some of the methods employed by Dowty Mining Equipment, Ltd., Ashchurch, Glos. (a member company of the Dowty Group) for producing typical sub-assemblies for their Mark IV Duke hydraulic pit-props. Here, some further examples of work carried out in the preliminary fabrication section are considered.

SWAGING THE OUTER TUBES

In preparation for "swaging" the outer tubes—as the operation of flaring the upper ends, to receive the split bearing-rings, is termed—the end of each is chamfered on the Lodge & Shipley lathe shown in Fig. 1. Mounted on the saddle is a fixture incorporating vee rests, in which the work is held by air-operated latch-type clamps. For loading, each of the arms A is swung to the rear, by an associated pneumatic ram, so that the latches can be raised. A tube is placed on the vee rests and backed against an end-stop, and the latches are returned to the working position. When air

is admitted to the cylinders, by means of the manually-operated valve B, the arms A are swung forward, and a roller on each arm moves on to an inclined face on the latch, so that the latter is thrust downwards. Each latch is provided with a pivoted equalizing pad, to distribute the clamping pressure.

A high speed steel cutter is mounted on the head-stock spindle, which is run at 196 r.p.m., and the work is advanced against it by traversing the saddle by hand feed, the movement being limited by a fixed stop. This stage is completed in 1½ min. per tube, and the angle of chamfer is such that when the swaging operation has been carried out, the end-face is flat. As each tube is unloaded, it is placed on the gravity roller-conveyor seen in Fig. 1 for delivery to a 25-kW. Delapena induction heating machine, on which the end to be swaged is first annealed. The annealed length must be accurately controlled, otherwise the tube tends to bulge behind the flare during the swaging operation.

In Fig. 2 is shown a close-up view of the working zone of the induction heating machine, the cycle of which is linked, automatically, to that of the swaging machine. Initially, the movement of the tube along the conveyor is arrested by the air-operated stop C, which is actuated by the ram D. This stop serves to locate the work in the required longitudinal



Fig. 1. This Lodge & Shipley lathe is used for chamfering the outer tubes, in preparation for swaging, before they are passed to an induction heating machine, seen in the background

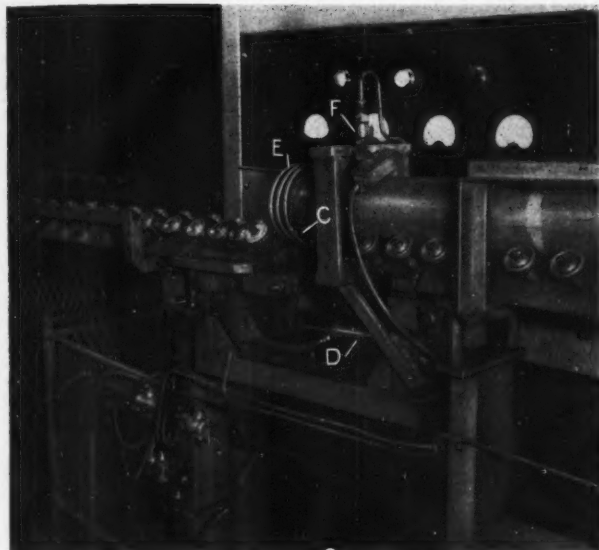


Fig. 2. In this close-up view of the Delapena induction heating machine employed for annealing the tubes may be seen the inductor-coil, stop, and conveyor. The cycle is automatically linked to that of the swaging machine

position, in relation to the inductor-coil *E*. When the operator at the swaging station starts the automatic cycle of his machine, that of the induction heating machine is also initiated. The work is then clamped by two pneumatic rams, one of which may be seen at *F*, the inductor coil is energized, and the stop *C* is swung clear.

After a heating period of 38 sec., the current is switched off, and the rams *F* are raised to release the work. As the heated tube is carried clear of the coil, on a continuation of the roller conveyor, it trips a micro-switch to return the stop *C* to the working position, in readiness for the next cycle. At

the end of the roller conveyor there is a cooling rack, shown in Fig. 3, which serves the swaging machine. When the heated tube reaches the final section of the roller conveyor, it trips another micro-switch, and a section of conveyor is tilted sideways, and returned, by the pneumatic ram *G*, so that the tube is delivered into the upper end of the cooling rack. As may be observed, the rack is of a double-incline type, and the lower section is arranged to deliver the cooled tubes directly to the swaging machine, as shown in Fig. 4. This view also shows the turn-over portion *H*, of the roller conveyor, and the ram *G*.

As each tube reaches the bottom of the cooling rack, it rolls on to an air-operated lift platform *J*, Fig. 4, whereby it is raised into line with the swaging mandrel *K*, of the machine. The upward movement of the platform is selected by the opera-

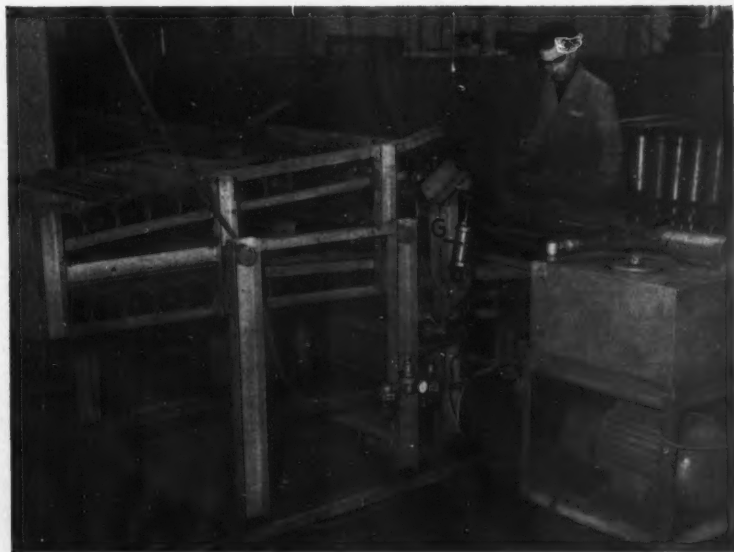


Fig. 3. This cooling rack, into which the heated tubes are delivered, serves the swaging machine. The final section of the roller conveyor is tilted sideways, by the pneumatic ram *G*, to discharge the tubes into the rack

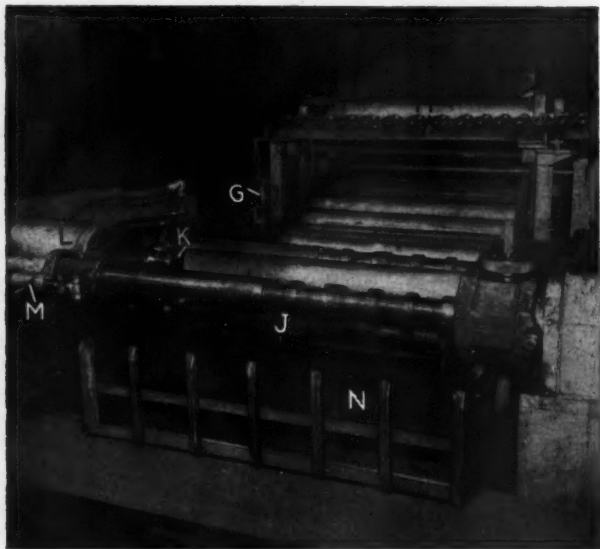


Fig. 4. This view of the swaging machine, in which the swaging mandrel is indicated at K, shows the arrangement for delivering the tubes from the rack, and raising them into position by means of the lift J

tor, by means of a control-valve, and he then starts the automatic cycle of the machine, which is hydraulically operated. As the swaging mandrel is advanced into the end of the tube by the ram of the large-diameter cylinder L, another valve is tripped, to lower the platform J, to receive the next tube. When a predetermined swaging pressure is reached, the mandrel K, the cross-head on which it is mounted, and the main ram, are retracted, by a pair of return-cylinders M. As the swaged tube falls clear of the mandrel, it is delivered into the tray N, at the front of the machine, whence it is removed and placed in a stillage. Prior cooling of the work, it may be noted, ensures that properties of the material, reduced by annealing, are substantially restored by the cold deformation. The machine was designed and built by the company.

WELDING THE PUMP CYLINDERS

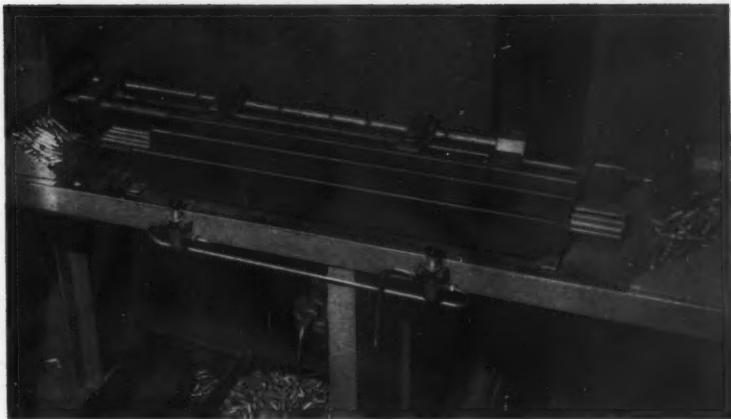
Another operation that is performed in the preliminary fabrication section is the arc welding of the pump cylinders to the piston heads. In

the side of each welding booth, there is a 2-station turn-table of the design shown in Fig. 5, which incorporates a plate P that serves as a partition. While one fixture is in use, within the booth, the other, outside, is accessible to a "chipper loader". The piston head is located on the circular table Q, by a spigot that engages the non-return valve bore, and the cylinder is inserted in a recess in the head. A shouldered plug, placed in the cylinder, is engaged by the spring loaded centre R, which is raised, for loading, by means of a lever. The relief valve bore is protected against weld spatter by a loose plug. During welding, the work is rotated by means of the hand-wheel S, and as soon as the welder has completed one assembly, he indexes the turn-table to bring the next into position, so that he is able to work almost continuously. At the next stage, the release



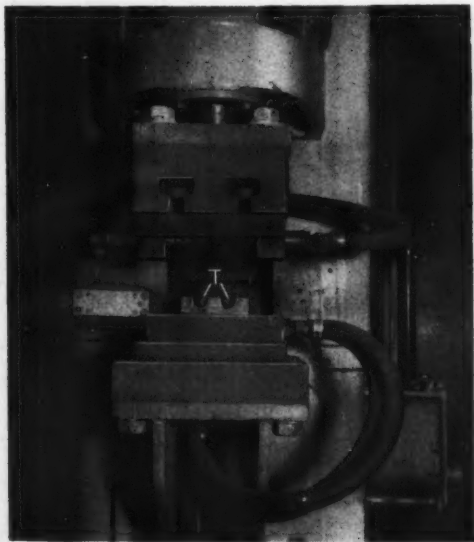
Fig. 5. For welding the pump cylinders to the piston heads, 2-station turn-tables are employed. One fixture is loaded while the other is in use, so that welding can proceed almost continuously

Fig. 6. On this simple air-operated machine, the end fittings of the tubular release valve push rods are inserted simultaneously. There are two control buttons, to ensure that the operator's hands are clear of the working zone



valve push rod sleeve is welded, and the work is then thoroughly cleaned.

In the same section, the release valve push rods and the pump connecting rods are assembled and drilled. Each push rod comprises a length of 18 s.w.g., $\frac{7}{8}$ -in. diameter steel tube, with pressed-in and spot welded end fittings, which are inserted in the tubes with the air operated equipment shown in Fig. 6. A length of tube is supported in a series of rests, and an end fitting is placed in a hollow mandrel that is arranged in line with the tube, at each end. The mandrel at the left is fixed, whereas that at the right is air operated. To facilitate their entry into the tubes, the shanks of the end fittings are tapered, with a radius at the junction of the shank with the outer portion.

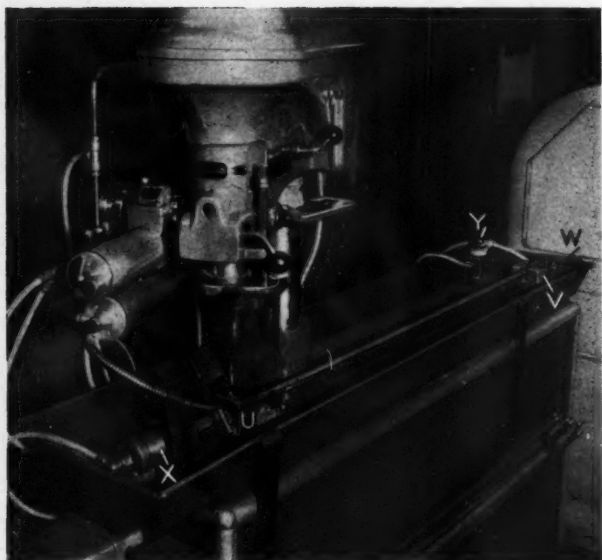


When two buttons, seen at the front of the bench, are pressed simultaneously, the two fittings are forced home to the required depth, which is controlled by the travel of the ram. With this equipment, the fittings are assembled to each tube in a floor-to-floor time of $1\frac{1}{2}$ min.

An unusual arrangement of electrodes, as shown in Fig. 7, is provided on the A.E.I. machine employed for spot welding the end fittings to the tubes, with two welds per fitting. The bottom electrode is in the form of a block with two semicircular recesses, and in line with each recess there is a back stop *T*, of the same material as the block. A cylindrical member, arranged transversely, forms the upper electrode. Welding is carried out by inserting the work in one of the semicircular recesses, against the back stop, operating the machine, rotating the work through 180 deg., and again operating the machine, to form the second weld. With the work reversed, end-for-end, and located in the second recess, the procedure is then repeated.

Welding is followed by the drilling of the cross pin hole, at the set-up in Fig. 8. The forked end of the work is located by two tongues in the fixture *U*, and the opposite end, by the back-up block *V*, which is adjustable longitudinally on the bed, to accommodate rods of different lengths.

Fig. 7. This unusual arrangement of electrodes on an A.E.I. welding machine is employed for producing the two spot-welds that secure each end-fitting. Each semicircular recess serves to locate one end of the work



When the lever W, on the back-up block is depressed, the work is clamped axially by the pneumatic ram X, and it is then drilled with the Meddings Pacera head, which is equipped with an air operated automatic feed attachment. The $\frac{1}{4}$ -in. diameter high speed steel drill is run at 1,400 r.p.m., and on completion of the drilling cycle, the operator withdraws the ram by depressing the button Y. This machine, on which a component is drilled in a floor-to-floor time of 30 sec., is tended by a deaf-and-dumb operator. A generally similar machine, with two Pacera drill heads, is employed for the pump connecting rods.

ASSEMBLING THE BREATHER VALVES

As indicated in the preceding article, some of the more complex sub-assemblies, such as the relief valves and breather valves, are assembled in a department devoted exclusively to this work, separate from the main production lines. Subsequently, these items are issued from the storage

Fig. 9. With this rig, the breather valve sub-assemblies are checked, two at a time, for low pressure reseating characteristics. The pressure applied is indicated on the water column manometer tubes

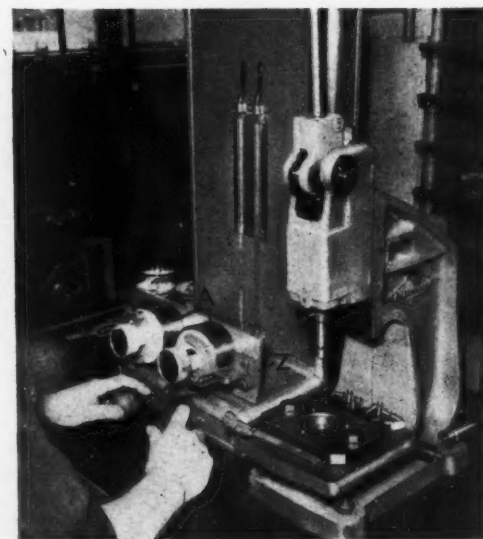


Fig. 8. This special-purpose machine, which is tended by a deaf-and-dumb operator, is employed for drilling the cross pin holes in the push rod end fittings, in a floor-to-floor time of 30 sec. each

area, directly to the appropriate line stations, whereas the basic components required for fabrication are fed to the lines on the overhead conveyor system, in sets.

The breather valves are assembled by a team of four operators, the first of whom de-burrs the machined portions of the die cast bodies, with the aid of a simple fixture. This fixture has a ring, mounted at an angle of about 30 deg. to the horizontal, on a fairly heavy circular base. The valve body is placed with the flange upright in the ring, and rotated, for deburring the peripheral sealing ring groove, and with the flange flat in the ring, resting on an internal shoulder, for de-burring the edges of the closure plate recess in the top of the cup. A similar fixture is used by the next operator, who assembles the filter gauze round the neck of the cup, and secures it with a short length of dovetail section rubber, which is pressed

Fig. 10. The equipment here shown is employed to facilitate the assembly of the relief valves. The special tool seen in the operator's hand serves to locate the valve seat while the body is screwed on to the plug



into a corresponding undercut recess, to trap the turned-in edges of the gauze.

The third operator places the lead ball in the cup, inserts the closure plate in the recess, and rolls over a lip surrounding the recess, to retain the plate. This operation is performed on a bench drill, and the tool is provided with three rollers, inclined at 45 deg. to the vertical. The same operator inserts the rubber valve-seat ring, and snaps the ring seal into the peripheral groove. At the next station, the fourth operator pushes the valve-seat ring home, inserts the ball, spring and plug, and temporarily retains these items in the body by means of a right-angled claw, the shank of which is inserted in the retaining-bolt hole.

With the components temporarily retained in this manner, the valve sub-assemblies are checked, two at a time, on the rig shown in Fig. 9. To facilitate loading, and to simulate working con-

ditions, the fixtures are mounted on a hinged plate Z, which is initially horizontal, with the fixtures upright. Each fixture represents the upper end of the prop inner tube, and comprises a cup A, the bore of which is closed by the peripheral ring seal. The assemblies are secured by toggle-action clamps, and with the fixtures loaded, the plate Z is swung through 90 deg., to the position shown, so that the lead balls roll off the valve stems, thus allowing the valves to close under spring pressure. In service, it may be noted, this closure ensures that the hydraulic fluid cannot escape when the props are laid horizontally.

LOW-PRESSURE SEATING TEST

When the loaded fixtures have been moved to the testing position, the spaces within the cups are pressurized with air, to 8 oz. per sq. in., by means of the rubber bulbs seen at the front

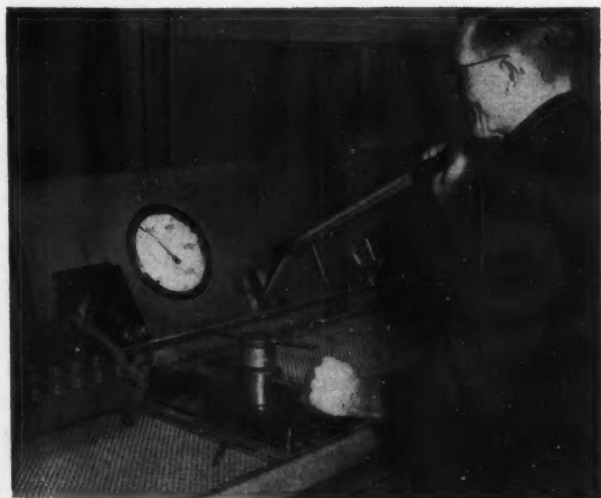


Fig. 11. On this hydraulic rig, the assembled relief valves are set to release at 3,655 lb. per sq. in., ± 40 lb. per sq. in., and are subsequently tested for re-seating, by applying pressure with the hand pump

of the rig. Meanwhile, the pressure applied is ascertained from a water-column manometer tube associated with each cup. When the required pressure is reached, and the bulbs are released, it is maintained by non-return valves. Any leakage in either of the valve sub-assemblies under test is then indicated by a fall in the level of the corresponding water column. The low air pressure employed for the check ensures that only valves with good low-pressure reseating characteristics are accepted. Following this stage, the operator stakes-in the plugs, on the arbor press seen at the right in Fig. 9.

ASSEMBLING RELIEF VALVES

The relief valves are of an encapsulated type, designed for close cut-off and good reseating characteristics, and are pre-set to operate at a prop load of 20-21 tons. Assembly of the valves is carried out by one operator, the bi-manual layout being shown in Fig. 10. A 2-station fixture is provided, and assembly begins with the lock-nuts seen at B. Before the lock-nuts are loaded into the fixture, the ring seals are snapped into the grooves, with the aid of a tapered ferrule, and smaller ring seals are inserted in recesses in the upper ends.

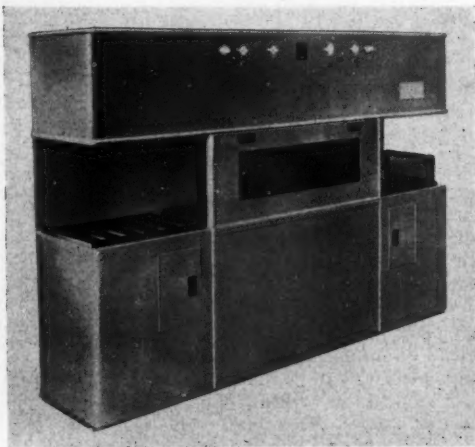
In the fixture, each lock-nut is located by the hexagonal portion, and a seating disc, the testing of which was described in the preceding article, is placed over the upper ring seal. Next, the cylindrical body, in which the valve assembly is completely enclosed, is screwed on to the plug portion, by means of the special tool shown. This tool engages the flats on the sides of the body, and is provided with a conical-ended, spring loaded pin C, which engages and locates the seating disc by the central aperture. The remaining details of the valve, comprising the ball, ball guide, spring guide and spring, are then inserted, and are retained by the adjusting nut, which is screwed into the upper end of the body.

Setting and testing of the valves is performed on the hydraulic rig shown in Fig. 11, where each in turn is held in a bayonet-lock adapter. Hydraulic pressure is applied by means of an air/hydraulic pump, and the valve is set to release at 3,655 lb. per sq. in., ± 40 lb. per sq. in., by reference to the pressure gauge. Once set, the valve is checked six times, by applying pressure with a hand pump, and observing, from the gauge, the pressure at which it reseats.

Some further examples of the methods employed in the sections devoted to main fabrication, assembly and testing, will be discussed in a later article to be published in MACHINERY.

Revel Industrial Cleaning Equipment

Products of Revel Engineering Co., Ltd., Hayes Road, Southall, Middlesex, include automatic



Revel type CT30A two-stage industrial cleaning equipment. Intended for use in a conveyor line, it has two 30-gal. tanks

industrial cleaning units for use in conveyor lines, and an example is shown in the accompanying figure. Known as the type CT30A, it incorporates two cleaning tanks each of 30 gal. capacity. Baskets of work, fed to the equipment by way of a roller track, move on to a roller table which is lowered by means of an air cylinder to immerse the work in the first cleaning tank. The table is then raised automatically, and an overhead travelling arm, which is also air-operated, transfers the basket of work to the table of the second cleaning tank, wherein it is immersed. Upon completion of the cleaning operation, the overhead arm moves the work basket to the unloading position.

The unit operates on compressed air at a pressure of 80 lb. per sq. in., and the sequence is controlled by an electric process timer. For heating the cleaning fluid, 4-kW., thermostatically-controlled immersion heaters are provided, and a canopy hood, which can be connected to ducting, extends over the full length of the unit. The dipping space in each tank measures 20 by 17 by 12 in. deep. A larger, 2-stage standard unit, known as the type CT60A, is available, which incorporates cleaning tanks measuring 26 by 20 by 16 in. deep, each holding 60 gal. of cleaning fluid.

Grinding Inner Races for Double-row Taper-roller Bearings

A TYPICAL APPLICATION of the Wotan type S 313/12U hydraulic internal grinding machine (Soag Machine Tools, Ltd., Juxon Street, London, S.E.11) is for operations on inner rings for double-row taper-roller bearings, during which the bore, the end faces, the tracks, and the associated thrust shoulders are finished at only two set-ups. A general view of the type S 313/12U machine, with a bearing ring in position on the faceplate, is shown in Fig. 1. A feature of this machine is that the work-head has a transverse movement of 44 in. and can be swivelled about a vertical axis through 90 deg. In addition, the grinding head can be swivelled through 20 deg., also about a vertical axis.

At any angular setting of the work-head between 0 and 20 deg., the machine will swing 51 in. diameter, and at other settings between 20 and 30 and 30 and 90 deg., it will swing 44 and 40 in. diameter respectively. With a 14-in. diameter grinding wheel, a maximum bore size of 48 in. can be ground. The grinding head slide has a movement of 48 in., which provides for grinding bore depths up to 28 in. Other machines in the type S 300 range have capacities for workpieces up to 48, 44, and 40 in. diameter with the work-heads at any setting between 0 and 20 deg. The transverse adjustment of 44 in. for the work-head is common to all machines in the range, as are the grinding head stroke and maximum depth ground (quoted above).

The various stages in the sequence for grinding the bearing ring seen in Fig. 1 are shown diagrammatically in Fig. 2. At *a* it will be noted that the work-head and grinding spindles are parallel, and the bore of the ring is ground in the conventional manner. A range of ten feeds is available for the grinding head, from 0.0001 to 0.001 in., on diameter, and an increment is applied hydraulically at the end of each pass. The selected feed rate is automatically changed to 0.0001 in. per pass

for finishing, and the feed is automatically disengaged when the required size has been reached.

For grinding one track, as at *b*, Fig. 2, the work-head is swivelled to the required angle and is moved transversely and clamped. The grinding spindle is also swivelled and the wheel is dressed to a tapered form. Power traverse for the transverse movement of the work-head is controlled by push-buttons, and accurate setting of the heads is facilitated by the use of gauge rods and dial indicators. Only a small reciprocating stroke is required for the grinding head at this stage, and the minimum movement of $\frac{1}{8}$ in. is employed.

Next, the machine is set for grinding one of the thrust shoulders at the centre of the bearing ring, and the disposition of the work-head and grinding spindle for this operation are shown at *c* in Fig. 2. The work-head is swivelled to bring the shoulder face parallel with the centre line of the machine. A tapered grinding wheel is again employed, and the spindle is swivelled to a setting equal to half the included angle. For this stage, no reciprocating motion is required, and it will be appreciated that the design of the race must be such that the angle of the thrust shoulder is sufficiently great to allow the grinding wheel to be introduced without interfering with other faces on the workpiece. Setting is facilitated by the use of gauge rods and dial indicators.

The last stage provides for grinding one end face,

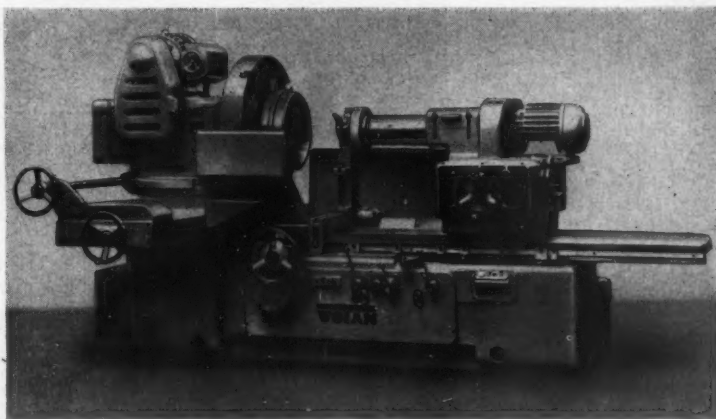


Fig. 1. Wotan type S 313/12U hydraulic grinding machine set-up for operations on an inner ring for a double-row taper roller bearing

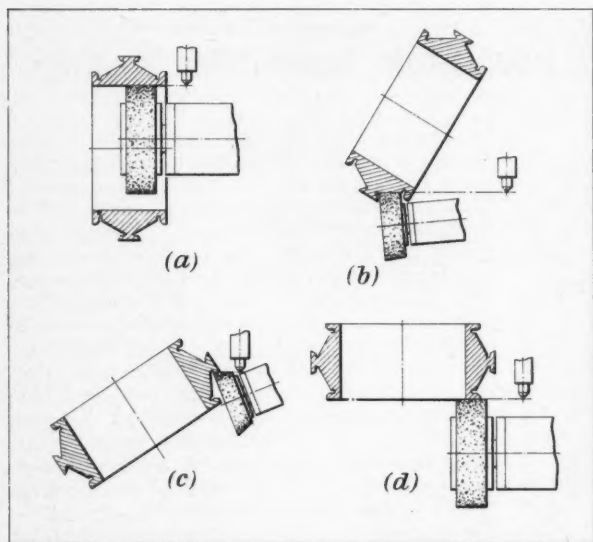


Fig. 2. Four stages in grinding the bearing ring are here shown diagrammatically. At the end of the sequence, the ring is removed and turned end-for-end, to enable the remaining faces and track to be ground

and for this operation the work-head is swivelled through 90 deg. as seen at *d*. The grinding spindle is returned to its normal position and the operation is carried out with the periphery of the same wheel that was used to grind the bore, as at *a*. Feed is applied incrementally, as for internal grinding. For the remaining track and faces, the bearing ring is removed, and turned end-for-end.

Thermatool High-frequency Fin Welding

The patented Thermatool high-frequency resistance welding process developed by the New Rochelle Tool Corporation, 320 Main Street, New Rochelle, N.Y., U.S.A., is now, it is stated, being used by numerous firms in various countries.

Reference has already been made in *MACHINERY*, 95/377—2/9/59, to the process, for which high-frequency current, up to 450,000 cycles per sec., is employed. The current follows the low inductance path rather than the low resistance path, and the skin effect results in localized heating of very high intensity. It is claimed that the high-frequency resistance technique thus

affords the same possibilities and advantages for seam welding, as do spot and impulse welding for joining metals at specific points, and enables high quality welds to be produced at exceptionally high speeds.

The technique is particularly intended for pro-

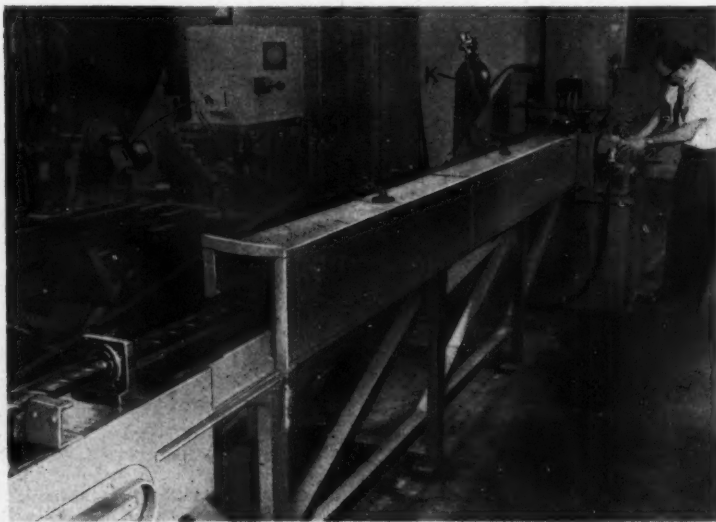
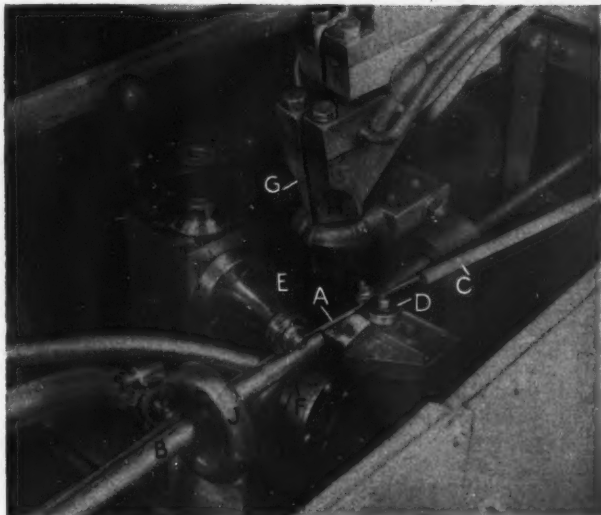


Fig. 1. Thermatool high-frequency resistance welder and draw bench for welding spiral or parallel fins to the surfaces of tubes

Fig. 2. Close-up view of the Thera-tool welding head with the electrodes raised clear of the fin strip *A* and the tube *B*

ducing tubing of ferrous and non-ferrous metals, including 100 per cent conductivity copper, stainless and galvanized steel, hot and cold rolled steel, and the rarer metals such as zirconium and titanium. Also, metals with different characteristics can be welded at high speeds, for example, copper to steel, and high-speed steel to carbon steel. The same welding head can be used to weld, continuously, various metals and alloys ranging in thickness from 0.004 to $\frac{1}{8}$ in., at speeds up to 1,000 ft. per min.

In Fig. 1 is shown a specially-designed draw bench, used in conjunction with a Thera-tool high-frequency resistance welder, to weld a spiral or a parallel fin on to ferrous or non-ferrous tubing. One particular application, in the nuclear energy field, involves welding a zircalloy spiral fin to zircalloy tubing previously seam welded by the process. A close-up view of the welding unit is given in Fig. 2, which shows a parallel fin



A, being welded to the tube *B*, the latter being supported on a mandrel. The fin material, fed through the guide tube *C*, passes between rollers at *D*, and beneath the vertically-adjustable grooved roller *E*. Support for the tube is provided by the roller *F*.

There are two welding electrodes, seen at *G* and *H*, raised clear of the work. The electrode *G*, bears on top of the strip, and the electrode *H*, on the tube, alongside it. The tube and fin are brought together in an elongated vee, the root of the vee being located at the squeeze rolls *E* and *F* where welding takes place. For welding zircalloy and certain other metals, it has been found desirable to carry out the operation in a protective atmosphere, and argon has proved most effective for the purpose. The argon is introduced through holes in the ring distributor *J*, which is fed with argon from the bottle seen at *K* in Fig. 1.

The ends of the tube and the fin strip are locked together in the pull head of the draw bench, and when a spiral fin is required, the pull head is rotated by means of the helically grooved bar in the foreground of Fig. 1. A view of the welder with the front panel removed to show the output transformer is given in Fig. 3, where the zircalloy tube is seen at *B*, and the fin feed tube at *C*. In operation, the welding area is totally enclosed.

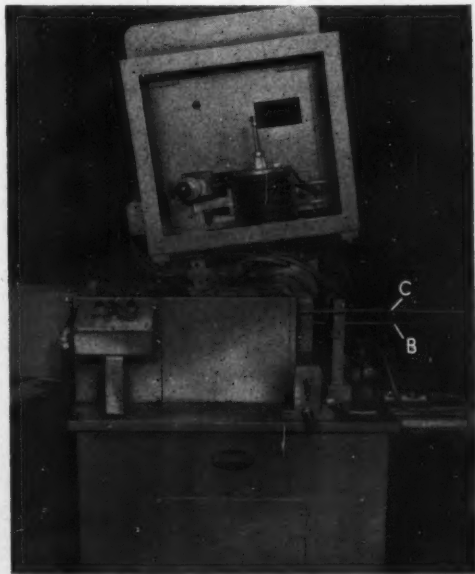


Fig. 3. View of the welding head with the front cover removed to show the output transformer

Producing Parts for Lang Pneumatic Equipment

Some Examples of Practice and Equipment Employed by

Lang Pneumatic, Ltd., Wolverhampton

By A. W. ASTROP, Associate Editor

AS WOULD BE EXPECTED, a number of set-ups at the Wolverhampton works of Lang Pneumatic, Ltd., provide interesting examples of the application of air-operated equipment to permit efficient medium-size batch production. The company's wide range of pneumatic equipment includes cylinders from $\frac{1}{4}$ to 20 in. diameter bore with a variety of stroke lengths and mounting arrangements, and numerous types of valves, fittings, and associated items from which complete circuits can be built. A typical application of the company's equipment to provide for air-operation of fixtures on a horizontal milling machine is shown in Fig. 1. This Somua type Z1B machine [Machine Tool Sales

(London), Ltd.] is used for plunge-milling operations on stainless-steel cores for solenoid valves made by the company, and is provided with a fixture at each end of the work-table.

Each fixture is arranged to hold three cores, and unloading and loading is carried out on one fixture while work in the other is being machined. At each stroke of the table, a $\frac{3}{8}$ -in. wide slot is plunge-milled in each core in one fixture by a 6-in. diameter side and face cutter (The Brooke Tool Manufacturing Co., Ltd.). There are three of these cutters on the arbor, as may be seen in the close-up view in Fig. 2, where two solenoid cores are indicated at A. There are three slots in each core, and after each working stroke of the table the cores are removed from the fixture and re-loaded into the neighbouring seatings. Projecting tongues in the second and third seatings engage with the previously-milled slots and serve to locate the cores angularly, and with this arrangement the three slots are milled at 120 deg. spacing.

Each core is positioned vertically in the fixture, with the flanged-end uppermost, and is secured during milling by means of a sliding clamp, as at B. The tail of each clamp is connected, by way of a toggle arrangement, to a short-stroke double-acting air cylinder, as at C. The clamps are seen in the advanced (working) position in Fig. 2, and when air is admitted to the rod end of the cylinder C, the piston rod moves to the left and the arms of the toggle close slightly. As a result, the tail of the clamp B is pulled down, and the nose is raised from the workpiece. Continued movement of the piston rod pulls the clamp to the left, exposing the component so that it may be lifted out of its seating and transferred

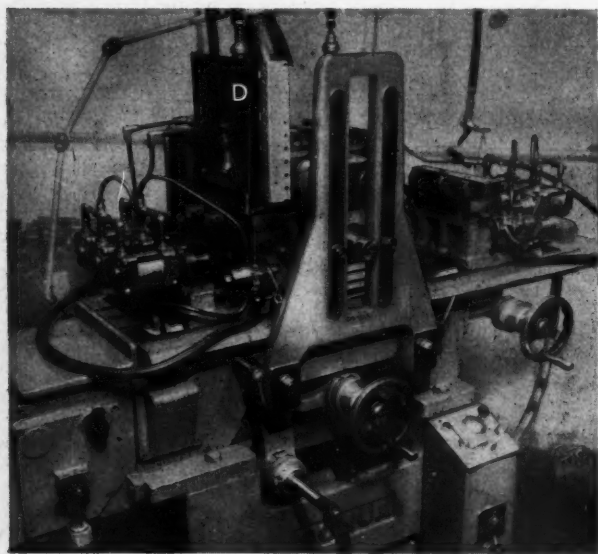


Fig. 1. This Somua horizontal milling machine is installed in the Wolverhampton works of Lang Pneumatic, Ltd., and is fitted with twin air-operated fixtures for plunge-milling operations on cores for solenoid-operated reversing valves

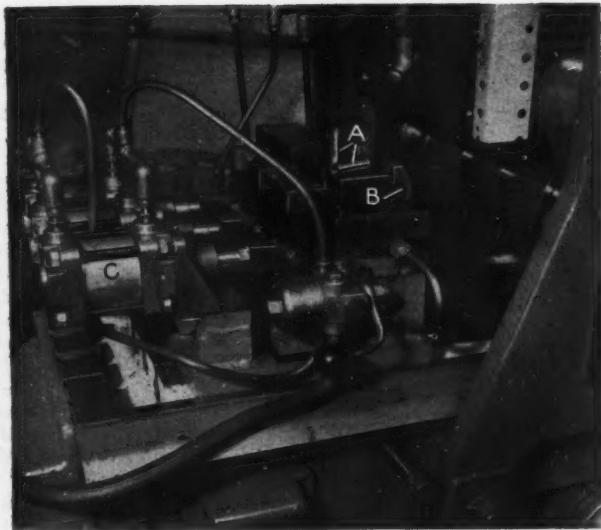


Fig. 2. Close-up view of the machine in Fig. 1, showing the toggle-action clamps and the three milling cutters

to the next position. To clamp a workpiece, the air supply to the cylinder is reversed by means of the lever-operated valve in the foreground. During the first part of the movement the clamp is pushed to the right, to abut a stop and the nose is thus brought over the workpiece. A final movement then serves to open the toggle slightly, with the result that the nose of the clamp is thrust down on to the component.

All three cylinders operate simultaneously under the control of the lever-operated valve at the centre, and, since thrust is applied by way of a toggle mechanism, the work remains securely held even in the event of a complete failure of the air supply. Another feature of this set-up is the provision of automatically-operated cutter guards. One of these guards is indicated at D in Fig. 1, and it comprises a plain sheet steel shutter which can

be raised and lowered by a double-acting air cylinder. As each fixture is advanced towards the cutters a valve is tripped to raise the adjacent guard. Simultaneously, the other guard is lowered, to cover the opposite edges of the cutters and to protect the operator while he is loading and unloading the other fixture.

AIR-HYDRAULIC CLAMPING FIXTURE

The company's solenoid-operated valves also incorporate small brass components known as slide carriers. This part is an approximate cube and one of the operations provides for milling a slot, of semi-circular cross section at the root, across one face, to a depth of about one-half the thickness of the cube. A finished milled workpiece is shown at E in Fig. 3, with a blank adjacent, and these parts are resting on a special fixture which has been designed and made by the company. Two rows, each of 10 blanks, are loaded into channels in the fixture, as shown, and are located

endwise by an adjustable plate at the left-hand end.

The rows of blanks are separated by a ground steel block, indicated at F, and are thrust against this block by a number of small axially-sliding plungers, one of which is shown at G. There is a separate plunger for each workpiece, and the

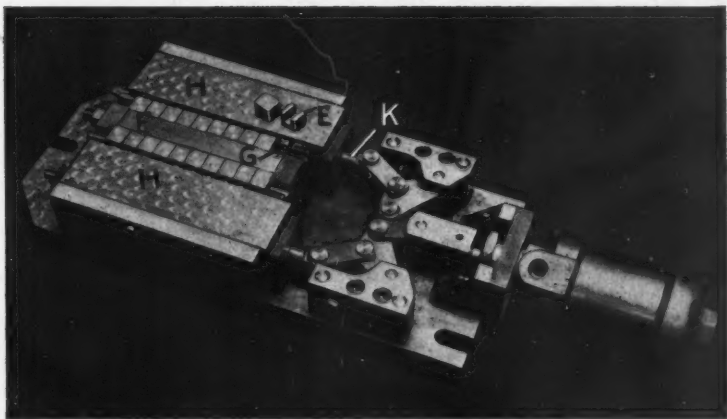


Fig. 3. Designed and built by the company, this air/hydraulic fixture provides for holding 20 small slide carriers for a slot-milling operation

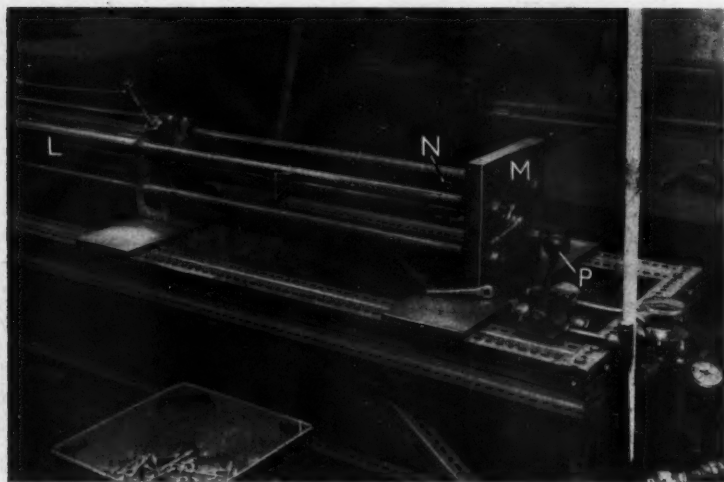


Fig. 4. This simple air/hydraulic broaching machine was designed and built by the company for operations on control levers for manually-operated air valves

plungers are advanced, to clamp the blanks, by oil pressure which is applied to the inner ends. The oil is contained within the compartments *H*, which serve as cylinders. Pressure is applied to the oil in each cylinder by means of axially-sliding pistons *K*, which are advanced and retracted by the air-operated toggle mechanism to which they are connected.

When the pistons are advanced, the small plungers *G* are moved laterally, to thrust the blanks against the block *F*. An adjustable stop mechanism is provided for each half of the toggle, to restrict the movement. When the air supply to the cylinder is reversed, and the pistons *K* are withdrawn, the resultant slight vacuum in the cylinders *H* ensures that the plungers *G* are also retracted. At the left-hand end of each of the cylinders *H* there is an adjusting screw, which imparts axial movement to a short piston. By use of these screws, the effective volumes of the cylinders can be adjusted. In this way, the pressure applied to the plungers *G* can be pre-set independently of the stroke of the toggle mechanism.

AIR-OPERATED BROACHING MACHINE

To facilitate machining square holes in the ends of operating levers for manually-controlled valves, for example, the company has designed and built a simple horizontal broaching machine, a close-up view of part of which is given in Fig. 4. A Lang

hydro-pneumatic cylinder is employed to provide an air-hydraulic broach-pulling arrangement, and part of the oil hydraulic cylinder is seen at *L*. The cylinders are of the foot-mounted type and are supported by a bed, built up from Dexion slotted angle. Tie rods from the right-hand end of the cylinder *L* serve to hold a flat steel plate *M*, which is bored to receive a guide bush for the broach. The latter has a tang, which engages with the forked end of the piston rod, and is secured in position by means of the rectangular-section key *N*.

In operation, the tang of the broach is threaded through a workpiece, and the guide bush in the plate *M*, and attached to the piston rod by inserting the key. By operating the valve lever *P*, air is admitted to the cylinder to retract the piston rod and pull the broach through the work. At the completion of the operation, the key *N* is withdrawn, and the broach removed. With this equipment, square holes are broached in workpieces which are brought to the machine either with rough cast square apertures or pre-drilled.

ESSHETE 1250 ALLOY STEEL. Samuel Fox & Co., Ltd., a subsidiary of The United Steel Companies, Ltd., The Mount, Broomhill, Sheffield, 10, have started commercial production of a new austenitic creep-resisting steel known as Eshete 1250 which is intended for service temperatures up to 675 deg. C. It contains chromium 15, nickel 10, and manganese 6 per cent, with smaller percentages of silicon, molybdenum, vanadium, niobium, and boron. This steel, it is stated, combines a high level of rupture strength with adequate ductility, good weldability, structural stability, and oxidation resistance at elevated temperatures for long periods. It also has good manipulation properties and is claimed to be well suited for service in power stations of advanced design. Bars, tubes, pipes, and large forgings have been produced satisfactorily, and trials with sheet are in progress.

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The Mechanics of Chip Formation*

By S. N. AGRAWAL,¹ R. D. HARRIS² and B. H. AMSTEAD³

THERE ARE MANY THEORIES associated with the cutting of metal. Some investigators have likened the process to a successive shearing action. One reported that in addition to shear, other considerations involved are grain compression, the slip of cleavage planes, rotation of slip planes, and "twinning." Another has visualized chip formation as being akin to the flow of viscous material over the tool face, similar in nature to that which occurs in squeezing or upsetting. A recent theory discards the idea of a shear plane and states that deformation during metal-cutting is continuous.

In an effort to secure more information on the process, a technique was developed whereby basic data on metal-cutting may be rapidly recorded, and subsequently analysed. The equipment and set-up employed are shown diagrammatically in Fig. 1.

In order to minimize the difficulties encountered in photographing chip formations at high speeds, a shaper was converted into a "planer." For this purpose, the tool and the work were "reversed," the work being secured in a fixture on the ram and the tool being rigidly held in the vice on the shaper bed. The camera was mounted in a fixed position on a table attached to the bed and was focused on the tool tip.

A $\frac{7}{8}$ -in. square Rex AAA high-speed-steel cutting tool, supplied by the Crucible Steel Co. of America, was used for all the tests. The backrake angle varied from 15 to 30 deg. and the relief angle was 8 deg. A strain gauge, fitted to the tool-holder, indicated tool forces and the resulting vibration. Strain-gauge response was magnified by means of a

with maximum camera speeds from 3,000 to 7,000 frames per sec. A 110-volt, d.c., carbon-electrode lamp provided light for photographing the image, and a vertical illuminator from a metallographic microscope was incorporated in the objective lens attachment to direct light on to the subject. Additional light was focused on the subject by a parabolic-shaped mirror accurately located to collect rays which "spilled" around the lens section.

A micro-switch attached to the shaper ram provided for starting the camera at the correct time. Also, a neon timing light, flashing 120 times per sec., exposed the edge of the film. The camera speed could thus be determined from the number of frames between exposed areas.

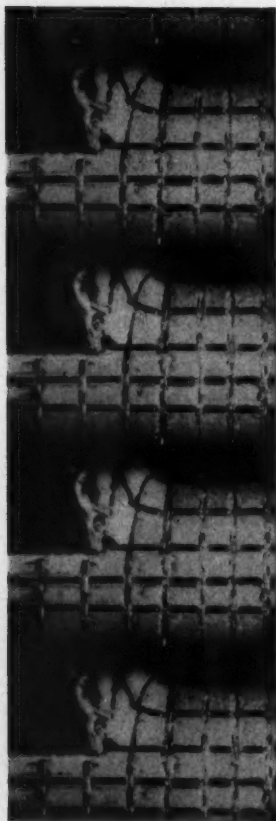


Fig. 2. High-speed photographs showing the cutting of Beeswax. The resulting deformation in the grid of scribed lines helps to illustrate the stress pattern that developed

With the arrangement described, high-speed photographs were taken of polished and etched steel being cut at realistic speeds, and at the same time a record of tool forces was obtained. As mentioned, a magnification of $5\times$ was used in photographing the subject, and when the developed film was projected on a screen, a magnification of approximately $200\times$ was possible. At this magnification some grain structure was visible, and deformation details could be viewed.

During the study, some of the data were obtained without recording the tool forces. One of the first materials cut was beeswax, with a

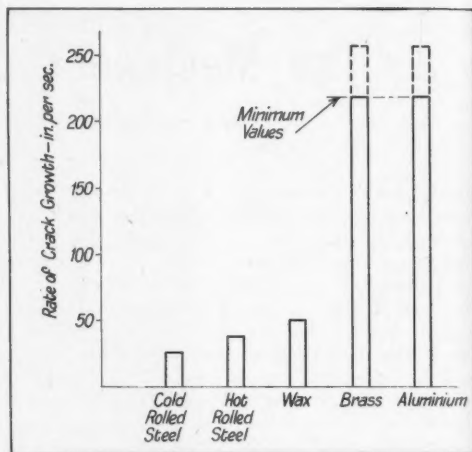


Fig. 3. Relative rates of growth of cracks across chips made brittle by strain hardening due to cutting action

specific gravity of 0.960 and a melting temperature of 154 deg. F. Many of the phenomena observed in subsequent tests on mild steel, brass, and aluminium had certain parallels to those associated with the cutting of this wax. A $\frac{3}{8}$ -in. wide specimen, with grid lines scribed 0.050 in. apart, was employed. The cutting speed was approximately 50 ft. per min., and the depth of cut, 0.10 in., and the tool employed had an 8-deg. relief angle and a 20-deg. back-rake angle.

A film strip taken at 7,200 frames per sec., as shown in Fig. 2, illustrates the stress pattern that developed during the machining of the beeswax specimen. Deformation began well ahead of the tool point and was apparent not only in the body of the chip but below the machined surface. The wax deformed into the chip in parabolic fashion, the horizontally scribed lines being carried off with the chip. The vertical lines were compressed in the chip but remained approximately parallel. Near the end of the cut, cracks began to appear in the chip next to the tool face. These cracks were approximately $\frac{1}{8}$ in. apart and became wider and deeper as the cutting speed of the shaper reached the maximum. The cracks extended in a direction roughly at right angles to the tool face and were sufficiently deep to extend two-thirds across the width of the chip. Appearance of these cracks was unexpected inasmuch as the wax was thought to be ductile enough to take the strain without fracture.

One investigator has observed that two types of cracks are formed during metal-cutting, both of which result from maximum normal stress, namely

spontaneous cracks that form rapidly in a perfectly brittle material, and relatively slow-growing cracks associated with plastic deformation.

Since the cracks were more prominent in the wax at the higher cutting speeds, it might be reasoned that the strain rate was more severe because of the greater speed. It is generally accepted that most materials are more brittle at high strain rates.

The relative rate at which brittle cracks were propagated across chips of various materials is shown in Fig. 3. Rate of crack growth was determined by counting the number of frames between the beginning and the end of the formation period, the speed of the film being known. There was very little variation in the observed data due to tool modifications or moderate changes in cutting speeds.

This technique may be refined to obtain very accurate values of crack growth rates in various materials. Cracks always appear to grow from the face of the tool towards the free side of the chip. Since the material next to the tool face is most severely strain-hardened, growth would be expected to begin there. In most cases, the crack did not extend completely across the chip, as less strain hardening occurs in the outer portion.

In all the materials studied, cracks probably began, in part, from smaller cracks or non-homogeneous areas in the metal. This theory partially explains why cold-rolled steel showed more frequent, but less severe, cracks than hot-rolled steel. Cold-rolled steel is strain-hardened in the rolling process, grain structure is more refined, and the inclusions and small non-homogeneous areas are more widely distributed.

A photograph from a film strip taken at 6,500 frames per sec. of cold-rolled 1018 steel being cut

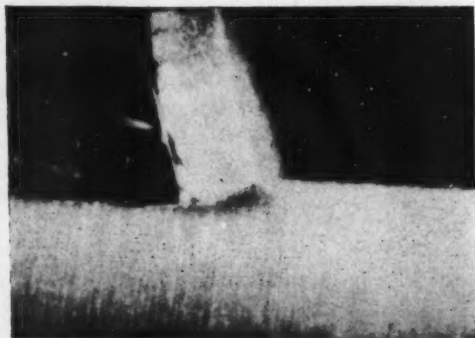


Fig. 4. Photograph taken at 6,500 frames per sec. showing cold rolled steel being cut at 75 ft. per min. Cracks have formed in the chip



Fig. 5. Hot-rolled steel is here being machined at 75 ft. per min. Shear angles varied from approximately 20 to 30 deg.

at 75 ft. per min. and a 0.020-in. cut is shown in Fig. 4. The back-rake angle of the tool was 20 deg. and the relief angle 8 deg. The photograph shows the beginning of a built-up edge and crack formation extending from the tool face toward the centre of the chip. The angle between the horizontal and a line drawn between the tool point and the point where the chip and free surface of the workpiece intersect, which is known as the shear angle, is 22 deg. There is no straight line of demarcation between the two points, however, and very high magnification revealed no deformation by slip.

Two photographs, both taken while machining A755T hot-rolled steel at 75 ft. per min., with a 0.020-in. cut, are shown in Fig. 5 and 6. The tool had a back-rake angle of 20 deg. and a relief angle of 8 deg. Both exposures were made at 6,000 frames per sec.

Although the shear angle of the cutting action in both Fig. 5 and 6 is 22 deg., the angle varied from approximately 20 to 30 deg. During the cut a built-up edge (Fig. 6) would begin to form slowly and suddenly grow very large, so that at times it was as much as one-third of the chip thickness. The build-up never remained stationary but instead travelled along the front of the tool. This motion occurred, however, at a much slower rate than the speed of the chip in passing the built-up edge. As the size of the built-up edge increased, so did the rate at which it passed off until both the build-up and chip had the same velocity. In the case of hot-rolled steel, large cracks began to occur in the face of the chip when the build-up passed off. Several cracks would appear in uniform succession at about $\frac{1}{8}$ in. apart, and grow larger at a rate of approximately 40 in. per sec. As soon as the



Fig. 6. Another photograph of the operation shown in Fig. 5. A built-up edge is seen being formed in front of the tool

build-up developed, however, the crack formation ceased. There seemed to be no set pattern as to how long build-up lasted or how often it occurred.

The formation of a built-up edge appeared to be caused by the sticking or welding of some of the viscous particles to the tool. This build-up edge, in turn, became the cutting edge. As more of the viscous material stuck to previously adhering particles, instability resulted. When the frictional resistance between successive layers of viscous particles became greater than the frictional resistance between the built-up edge and the tool, the built-up edge would slough off. Since the built-up edge becomes the primary cutting edge during the periods when it is in front of the tool, the sharpness of the basic tool is quite possibly needed only occasionally during a cut in order to set up a well balanced plastic deformation and the proper compressive conditions.

The result of build-up was to increase the effect of shear angle, since the build-up appeared as a rough tool point. A line drawn from the tool point to the point where the chip turned up did not appear to change because of build-up or crack formation alone. When cutting both hot- and cold-rolled steel, the shear angle was found to vary as much as 10 deg. in a few thousandths of an inch of cut without apparent reason.

There was no visible indication that chips left the workpiece as a result of successive shearing action. Instead, the workpiece showed deformation ahead of the tool both in the area where chip removal took place and in the material below the machined surface. The effect of compression and deformation could be observed from the films. The photograph reproduced in Fig. 7, for example, was obtained with a camera speed of 5,000 frames per sec. It

shows A755T hot-rolled steel being machined at 92 ft. per min. with a depth of cut of 0.020 in. The tool had a back-rake angle of 16 deg. and a clearance angle of 8 deg.

Unfortunately, with the technique described, it has been found difficult to photograph the grain structure clearly during the entire cut, owing to the undulating nature of the lighting, vibration, and focal length. Added refinements are expected to assist in improving photography, to permit more vivid recording of grain deformation and allow greater magnification in reproduction.

Although they are not shown here, photomicrographs of the workpiece after machining revealed distortion to a depth of several grain "diameters". The grains were deformed ahead of the tool, and in the direction of the cut.

In machining, there is also some lateral deformation—bulging out—of both the chip and the workpiece because of the intense compression ahead of the tool. The process resembles upsetting. Careful viewing of strips of the high-speed film reveals the material in front of the tool in what appears to be viscous form while flowing up the tool point. One can observe this viscous type flow along the face of the tool as well as in the material making up the chip.

It was reasoned that if a chip were predominantly formed by successive shearing action, the tool forces should vary at a frequency analogous to the rate at which the shearing action took place. A number of tests was therefore made during which the tool forces were recorded on the film together with the image of the chip being formed. Although the tool force varied during the cut, there was no correlation between tool

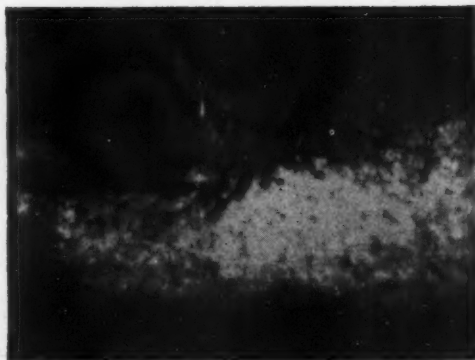


Fig. 7. The deformation seen here in front of and below the tool point occurred during the machining of hot-rolled steel at 92 ft. per min.

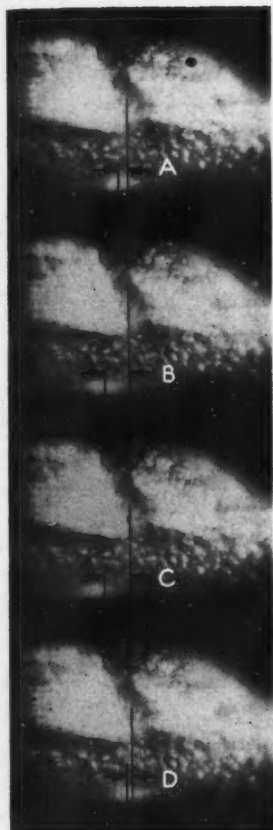


Fig. 8. Variation in tool force is indicated by the positions of the light beam on this film strip, which shows the machining of cold-rolled steel at 92 ft. per min. Lengths A, B, C, and D relate to momentary values of tool force

force and shearing action, so far as could be determined.

A portion of a film strip, reproduced in Fig. 8, which was taken at 3,000 frames per sec., shows a piece of cold-rolled 1018 steel being machined at 92 ft. per min., with a depth of cut of 0.010 in. The tool had a 16-deg. back-rake angle and an 8-deg. relief angle. These photographs clearly show the cutting tool, workpiece, chip, and beam of light which, by its distance (A, B, C, or D) from a fixed datum, indicates the value of the tool force. Although, as may be seen, the tool force varies considerably (from approximately 400 to 200 lb.), there is no indication that a shearing action has taken place. As this method is refined, considerable information on cutting-tool vibration characteristics should be obtainable. It has not yet been possible to utilize the data relating to

tool-force variations accurately to calculate which portions of the forces are transient and which are caused by natural vibrations. Punched tape and computer techniques are to be employed to achieve a better understanding of the data obtained.

In an effort to check the response of the light beam indicating tool force, a workpiece was pre-

pared with vertical $\frac{1}{16}$ -in. slots cut at various intervals. When the chip was separated from the workpiece, the tool force, in every case, fell to a zero value instantly. At the end of a cut, the base material beneath the tool broke off at a downward angle and not in the direction of the shear plane. Although it was observed that the material ahead of the tool point deforms in the direction of the cut, only during the final fracture of the chip away from the workpiece is it possible to observe any sharp demarcation of deformation or stress, and only then does tool force fall to zero. This technique of recording dual data in synchronism offers unusual opportunity to investigate the details of tool-force variation.

Initial results of the tests indicate that the cutting action is not predominantly one of shear, but one of continuous deformation. The action is a combination of compression, bending, and viscous flow, and slip and "twining" are involved to some extent. The material in front of the tool is compressed and ultimately fails as it escapes over the tool face in the form of a chip under high frictional resistance. Owing to the intermolecular cohesion in the part being machined, the grains are deformed in the direction in which the tool is moving when the tool force is applied. A free-body diagram of the material ahead of the tool may be likened in some respects to that of a cantilever, since the final separation of the chip is in the direction in which a fracture in this type of structure should occur. Further, the stress at failure and the deflection of a cantilever are proportional to its tensile strength. This relationship is in agreement with the established fact that machinability varies inversely with tensile strength.

CONCLUSIONS

From these tests a satisfactory analysis of metal-cutting, at least for materials such as mild steel, would be generally as follows:

First, the grain boundaries of the workpiece are apparently compressed in front of the tool. As a result, a slight lateral elongation of the material occurs. Then, under high compression, the grains in front of the tool are bent forward and distorted in the direction of the cut. Under these stresses (both in the direction of, and approximately at right angles to, the cut) the material fails and escapes over the tool in the form of a chip. Grains in the finished surface of the workpiece are distorted and it follows, therefore, that plastic deformation takes place in both the chip and workpiece. Because of the higher pressures and temperatures developed, the material in contact with the cutting edge is more viscous in nature than

the material in the outer part of the chip. Also, the high degree of strain hardening that takes place along the tool face promotes the growth of cracks from this face toward the chip centre.

The tool face and the chip flow shown in the high-speed photographs bear a resemblance to the bow of a ship ploughing through water, and an analogy to hydrodynamic flow appears plausible.

E.D.L. Silver Star Industrial Lighting Fittings

E.D.L. Industries, Ltd., Brereton, Rugeley, Staffs., have extended their range of industrial local lighting fittings by the introduction of a new type known as the Silver Star, which has been accepted by the Council of Industrial Design. In the figure, a Silver Star fitting is seen in use on a lathe. Two forms are available, namely the SSU/1 with universal base, and the SST/1 with a simpler alternative base.

Features of the fittings include a special form of hinge joint which allows 360 deg. movement, and, it is stated, remains permanently in adjustment. The flex is totally enclosed and will not kink or twist, and the reflector can be turned to direct the light as required. A switch is provided in the base, which has four conduit entries to permit horizontal or vertical mounting.

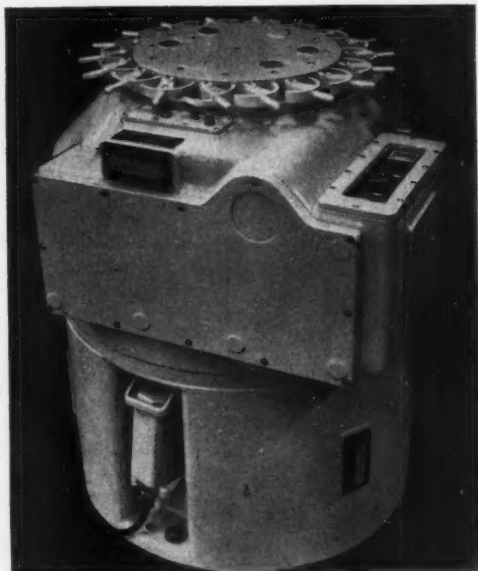
The fitting is suitable for use with a 60-watt lamp on mains voltage, or in conjunction with a step-down transformer for low voltage lighting. When extended it is 36 in. long and the weight is 5½ lb.



E.D.L. Silver Star local lighting fitting in use on a lathe

Pratt & Whitney Precision Rotary Table

Built by the Pratt & Whitney Co., Inc., West Hartford, Conn., U.S.A. (Buck & Hickman, Ltd.,



This Pratt & Whitney rotary table, which was developed for use in missile aiming systems, permits angular settings to be made with very high accuracy

Otterspool Way, By-Pass, Watford, Herts.), the precision rotary table here shown was developed primarily as part of an azimuth indicator in a missile aiming system. The accuracy of setting to any point within a full circle is claimed to be within ± 1.5 sec. of arc.

Setting is made with reference to duplicated sets of counter-type indicators, which are marked in deg., min., and sec. of arc and can be observed through windows. Provision is made for setting to a datum position by either turning the table while the counters are held at a pre-set reading or maintaining the table stationary while the counters are adjusted to zero. To ensure accuracy, warning lamps are illuminated if the correct procedures for the removal of backlash are not followed.

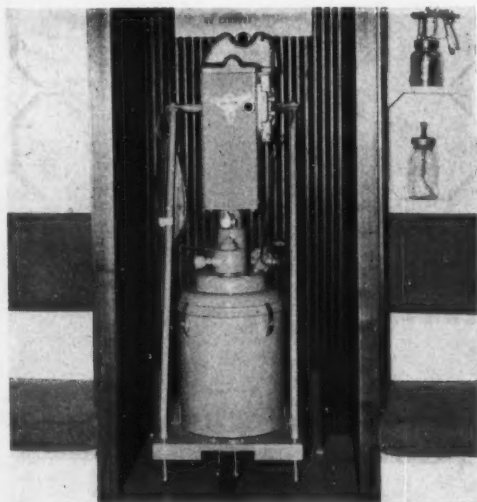
New Aerostyle Spraying Equipment

A new automatic painting and drying unit, built by Aerostyle, Ltd., Sunbeam Road, London, N.W.10, was among the equipment displayed at the recent Industrial Finishes Exhibition. This unit has been sold to Archibald Kenrick & Sons, Ltd., West Bromwich, and was demonstrated in use for finishing wheels for Shepherd castors made by this company.

Work is transported through the unit by a Chain-veyor overhead chain conveyor, driven by a variable-speed motor, and the conveyor can support a load of 60 lb. per ft. run. A total of 170 work carriers are provided, each of which will accommodate six components. Loading is performed by two operators, who transfer the parts from trays delivered by gravity roller conveyor. During the first stage of movement through the unit, paint is applied to the work by means of French-made S.A.M.E.S. Statron electrostatic equipment, for which Aerostyle, Ltd., are the agents in this country. The spray gun associated with this equipment is set at a distance of 8 to 10 in. from the work-path, and is operated continuously. For drying the paint, the work passes through four

heating galleries in a gas-fired infra-red oven, and then through an air after-cooler. Unloading is performed by a single operator, and the parts are deposited in a chute that directs them to a tray carried on a second roller conveyor. As an indication of the efficiency of operation, it is stated that an output of 4,000 wheels per hour is obtained, for the consumption of 2.6 pints of paint.

New hand-operated, electrostatic flock-spraying equipment was shown, and the display also included the Lincoln No. 1722 No-Air Dyna-Spray airless paint spraying unit seen in the illustration. Mounted on a wheeled trolley, which occupies a floor space of approximately 2 ft. square, the unit is self-contained, and incorporates a 5-gal. reservoir from which paint is drawn by a compressor and delivered at high pressure to the spray gun. A 100-mesh stainless steel filter is provided in the system. Various tungsten carbide spraying nozzles are supplied, and the gun is connected to the unit by a 25-ft. long Teflon plastics hose. A number of advantages are claimed for the airless spraying process, among which may be mentioned the very small amount of overspray obtained and the elimination of the tendency for paint particles to bounce from the work, so that extraction equipment is less frequently required. It is stated that the unit provides well-defined spray patterns, thereby reducing the need for masking, and the output of the compressor is such that the paint does not have to be heated.

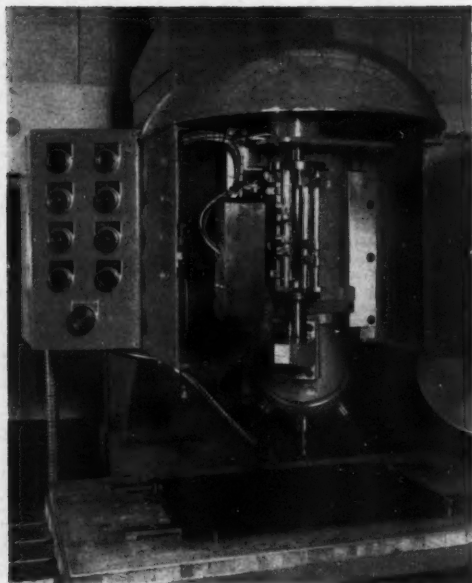


Lincoln No. 1722 No-Air Dyna-Spray self-contained airless paint spraying equipment

Tape-controlled Drilling Machine at the Leicester Works of A.E.I., Ltd.

At the electronics and marine radar works of A.E.I., Ltd., Leicester, a Vero co-ordinate setting, turret type, drilling machine, with Autoset N 271 tape control equipment supplied by Airmec, Ltd., High Wycombe, Bucks., is employed in the production of chassis for electronic units, which are often required in small batch quantities. As an indication of the output which is obtained, it is stated that operations involving the drilling of a total of 97 holes are completed in a cycle time of 12 min., and the need for jigs has been avoided. Programming is said to require no special skill, and is performed by a girl, who works direct from the detail drawings.

To facilitate positioning the work, a simple fixture is used, with a wooden baseplate, which is mounted on the machine table. With the aid of the control equipment, holes to accommodate three location pegs are drilled in this baseplate, in positions to suit the component. After loading, the work is secured to the base by means of screw-



For positioning work on a Vero co-ordinate setting drilling machine at the works of A.E.I., Ltd., Leicester, a wooden baseplate is employed, as here shown, with location pegs driven into drilled holes that are positioned by use of the control system

operated clamps, as can be seen in the accompanying close-up view of the working area.

In this illustration, the cover at the front of the machine head is swung aside to show the arrangement for controlling vertical movement of the drilling head. In connection with the feed motion, there are two adjustable stops mounted on each of a number of bars in a turret-type holder, which is indexed simultaneously with the spindle carrier. One or the other of the two series of stops which are thus provided is brought into position for operating the micro-switch associated with the feed mechanism by turning the bars manually. With this arrangement, holes of a maximum of 12 different diameters can be drilled, without the need for re-setting, by the use of stepped drills.

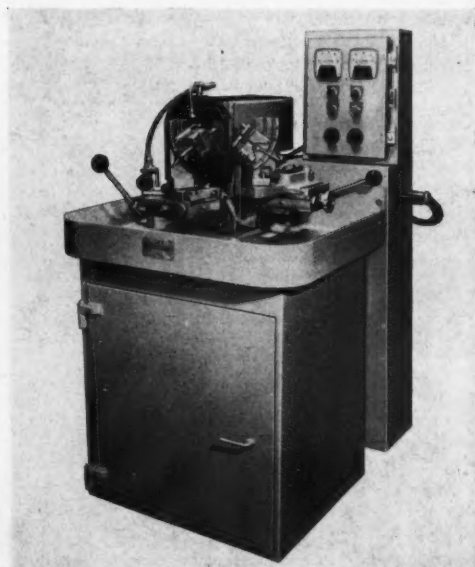
Autoset co-ordinate setting control equipment may be used in conjunction with machines of other types, and was described in MACHINERY, 93/616—10/9/58 and 95/1179—2/12/59, and the latter article was concerned primarily with the Vero machine. It may be recalled that movement of the table is determined by measuring

the angle through which the traversing screws are turned, and it is stated that settings are normally made and repeated to within 0.7 and 0.3 deg. of arc, the former corresponding to a movement of 0.0002 in. when a screw with 10 threads per in. is employed. Sole distributors for the Vero co-ordinate setting drilling machine are Catmur Machine Tool Corporation, Ltd., 103 Lancaster Road, London, W.11.

Ampak Electrolytic Twist Drill Sharpening Machine

In the illustration is shown the Ampak electrolytic machine for sharpening high speed steel twist drills, which has been introduced by Connecticut Special Machine, Inc., Winsted, Conn., U.S.A. With this machine, it is claimed, the time for sharpening a drill is greatly reduced, as compared with that required for grinding, and there is no risk of overheating the tool.

Point angles from 90 to 180 deg., and relief angles from 0 to 20 deg., can be produced on drills with helix angles from 30 deg. positive to 30 deg. negative, and the pre-determined point shape, it is stated, is controlled with high accuracy throughout large-quantity batches. A simple arrangement is used for holding the drill during the sharpening



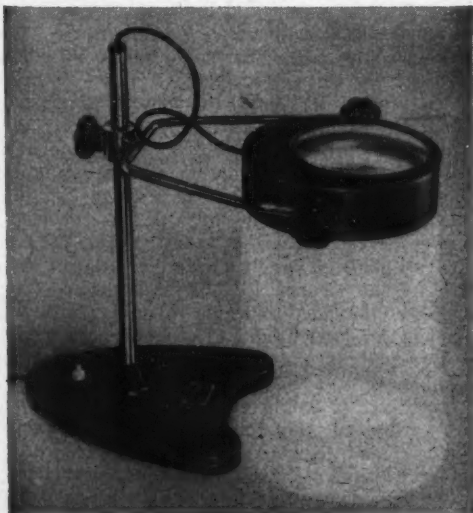
Ampak electrolytic twist drill sharpening machine

operation, and setting up can be carried out quickly.

Drive for the electrode wheel is taken from a 1-h.p. motor, and for electrolytic erosion, a power supply up to 300 amp. d.c., at a voltage which may be varied from 1 to 8, is provided by a self-contained unit, which incorporates a silicon diode rectifier. Control to within $\frac{1}{4}$ volt of the pre-set value is obtained by means of two valves, each of which has a guaranteed life of 10,000 hours. This power unit is also marketed separately, for use in other applications. A visual warning is provided in the event of overloading, and the electrolyte is circulated by a self-contained system. The machine occupies a floor space of 3 ft. 2 in. by 3 ft. 1 in.

Ellisviewer Bench Illuminator Magnifier

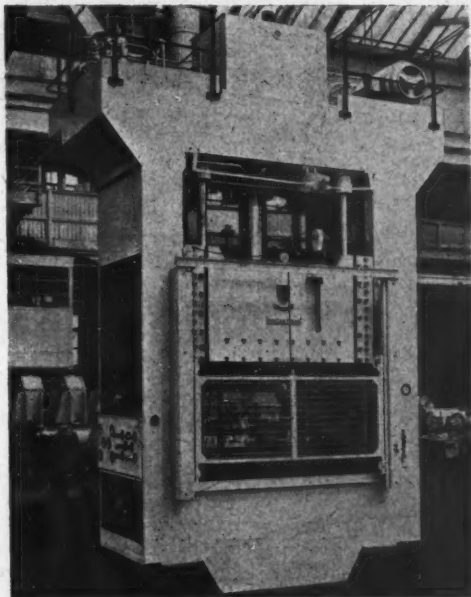
In the figure is shown the Ellisviewer bench illuminator magnifier which has been introduced by the Ellis Optical Co., Mayday Road, Thornton Heath, Surrey. The hood unit, in which are housed two electric light bulbs, carries a glass lens of 5 in. diameter, with a magnification of $2\frac{1}{2}\times$. This unit can be swivelled in its holder, and the latter is adjustable vertically on the column, so that the light can be directed at the best viewing angle, and the lens focussed to suit the work to be examined. A press-button switch for the light bulbs is incorporated in the base.



Ellisviewer bench illuminator magnifier

Foster, Yates & Thom Lancastrian 300-ton Triple- action Hydraulic Drawing Press

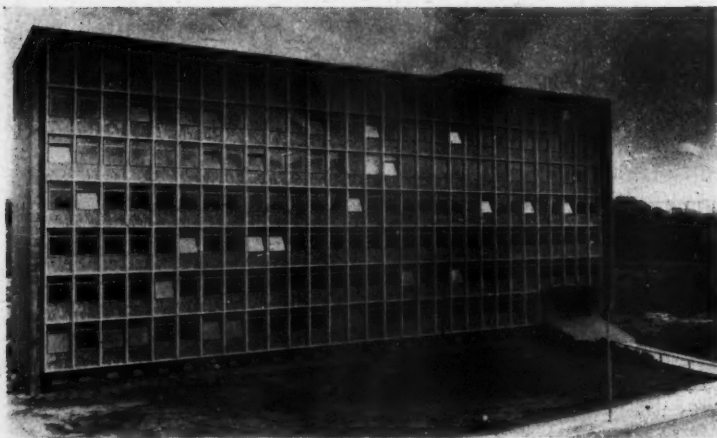
The accompanying illustration shows a triple-action Lancastrian hydraulic drawing press of 300 tons capacity which has been built for the Speed-



Foster, Yates & Thom Lancastrian 300-ton triple-action hydraulic drawing press

well Gear Case Co., Ltd., Tame Road, Witton, Birmingham, by Foster, Yates & Thom, Ltd., Blackburn, Lancs. It has a bed area of 7 ft. by 4 ft. 6 in., and the shut height is 3 ft. 8 in.

Features of this press include finger-tip control of the tonnage of the main ram and die cushion, and provision for adjusting, individually, the blank-holding pressure exerted by the four rams. In addition, the die cushion pressure can be automatically adjusted during the working stroke. The press performs an automatic cycle when the start button is pressed, and the ram can be arranged to stop and reverse when either a pre-set pressure or a predetermined position is reached. For single-acting tools, the sub-ram is used as a cushion.



The East German Institute of Machine Tool Engineering

By R. E. GREEN, Associate Editor

THERE ARE APPROXIMATELY 50 machine tool building factories in East Germany, and most of them are members of the Werkzeugmaschinenwerke association, which is usually abbreviated to W.M.W. These initials were adopted by the Modul gear-machine factory of Karl-Marx-Stadt, in 1949, and a badge on which they appear is now employed by members of the association as a mark of quality on their machine tools. Examples of the products of the East German industry, displayed at the Leipzig Spring Fair, have been described recently in *MACHINERY*,* and figures published in the periodical *German Export*, No. 7, 1961, indicated that some 42,500 metal-working machine tools, including both cutting and non-cutting types, will be built this year.†

Under the current 7-year plan for the expansion of the country's economy, which covers the period up to 1965, the output of machine tools is to be expanded to an annual rate of 110,000, and the greatest increase will be in non-cutting types. The plan provides for the supply of 22,000 automatic

machines, 300 transfer machines, 950 linked lines of machines, and 1,450 other machine lines, to be installed in various mechanical engineering factories between now and 1965, also for substantial numbers of machine tools for export.

Table 1, taken from the Statistical Pocket Book published by the Governmental Central Administration for Statistics, shows the numbers of selected machine tools built in East Germany during the years up to and including 1959, and although it does not include some of the more important types of machine it does afford some indication of the scale of operation. It is stated that the development of the industry in that country during the last five years has been largely affected by arrangements made by the Council for Mutual Economic Aid, which were intended to avoid overlapping or duplication of production, and to ensure that the best use was made of any new capacity which became available.

Investigations conducted by the Council showed that several of the communist countries were making similar machines, and engaging in research and development work along similar lines. Arrangements were therefore made to reduce such

* See *MACHINERY*, 98/939—26/4/61, 98/1006—3/5/61, 98/1074—10/5/61 and 98/1119—17/5/61.

† The figure of 65,000 quoted in the first of the earlier articles presumably included wood-working and other types of machines.

duplication, and it was laid down that the simpler machines should be built by the less industrially-developed countries, leaving more complicated and special machines to be built by those countries where industries have been brought to a higher technological level. These arrangements enabled the East German industry to reduce the number of different machines built by about 30 per cent, leaving some 338 types of cutting and 270 types of non-cutting machine tools in production, and these figures have since been further reduced by the adoption of the unit construction system, to which reference will be made later.

Another important factor which has encouraged East Germany to build the more complicated automatic machine tools, involving higher proportions of labour costs, is the shortage of raw materials. Much material has to be imported from West Germany and the communist countries, and to pay for such imports, large numbers of machine tools, are exported, to both communist and non-communist countries. The numbers of machine tools, of selected types, exported during the years 1955, 1958 and 1959, are shown in Table 2, also taken from the Statistical Pocket Book mentioned earlier. Comparison of the two tables shows that considerable proportions of the total outputs of some machines were exported in 1959.

THE INSTITUTE OF MACHINE TOOL ENGINEERING

Co-ordination of the efforts of the machine tool building factories, to avoid the duplication mentioned above, also research and development work

TABLE 1. EAST GERMAN PRODUCTION OF SELECTED TYPES OF MACHINE TOOLS DURING THE PERIOD FROM 1950 TO 1959

Type of Machine	Year			
	1950	1955	1958	1959
Lathes (all types)	4,422	4,851	4,513	5,501
Turret lathes.....	127	533	598	552
Automatic lathes	152	270	433	756
Milling.....	1,933	1,687	2,970	2,956
Jig boring	7	129	179	173
External cylindrical grinding	125	322	431	322
Internal cylindrical grinding	129	149	302	351
Single-spindle drilling (up to 0.75-in. capacity)	2,903	4,636	5,089	5,344
Radial drilling (up to 1.5-in. capacity)	89	100	142	159
Eccentric, crank- and toggle-type presses	556	984	2,028	2,023
Hydraulic presses	353	649	1,463	1,697
Guillotine shears	2,797	5,776	6,544	6,980

TABLE 2. EAST GERMAN EXPORTS OF SELECTED TYPES OF MACHINE TOOLS DURING THE PERIOD FROM 1955 TO 1959

Type of machine	Year		
	1955	1958	1959
Lathes (all types)	840	1,092	1,221
Turret lathes.....	58	134	154
Automatic lathes	103	151	161
Milling.....	906	972	1,149
Jig boring	26	66	63
External cylindrical grinding	97	124	108
Surface grinding	73	116	157
Radial drilling (up to 1.5-in. capacity)	31	64	89
Eccentric, crank- and toggle-type presses (of more than 125 tons capacity)	308	582	596
Hydraulic presses	268	607	793
Guillotine shears	770	1,475	1,052

on machine tools, is performed by the Institute of Machine Tool Engineering. Started some six years ago, this Institute was initially housed in scattered premises in the town of Karl-Marx-Stadt (formerly Chemnitz), in the district of the same name, bordering Czechoslovakia. In this district, it may be noted, there are more than 700 heavy engineering and other metal-working factories, producing machine tools including large lathes, milling and plano-milling machines, gear-cutting machines, and heavy boring machines, textile machinery, motor cars, lorries and motor cycles. Mining is also carried on in the area, which is the most densely populated in East Germany, with some 2.3 million of the total of 16 million inhabitants.

The various departments of the Institute have recently been concentrated in new, specially-designed buildings, the office block of which is seen in the heading illustration. Situated at Annaberger Strasse, 231, about two miles from the town centre, these buildings were erected at a cost of 7.3 million marks, equal to about £660,000 at the current exchange rate. In addition to the offices shown, the Institute buildings include a well-equipped canteen with kitchen and facilities for entertainments, and a large test hall, with workshops and offices, where machine tool design and operating problems will be investigated.

A view inside this test hall, taken when it was under construction, is given in Fig. 1, and it is about 246 ft. long by 30 ft. wide, and has a clear height of 26 ft. beneath the crane tracks. There are two cranes, of 5 and 12.5 tons capacity, and each has its own current-carrying bus-bars at the



Fig. 1. In this view in the new machine-testing hall of the East German Institute for Machine Tool Engineering, taken during construction, the vibration-insulated concrete rafts on which machines under test will be installed, may be seen at the left

right-hand end. These bars are supplied with current through sets of contacts arranged at intervals of about 6 ft. along the side of the building beside the right-hand track, so that there is no need for continuous bus bars. Windows occupy almost the whole of the left-hand wall, and the roof is carried on single-span, reinforced-concrete girders.

At the right-hand side there is a two-storey structure which adds about 20 ft. to the width of the building. A corridor, with windows in the wall of the test hall extends along this side, at the first-floor level, and affords access to the row of offices used by the test engineers; also a view over the test floor. Beneath the offices there are workshops and rooms which house equipment for the supply of compressed air, electric power and heat, also lathes, milling machines, and other machine tools for making special auxiliary attachments and components when required. The electrical equipment includes two Ward-Leonard sets for the supply of d.c. power to certain types of machines, and a 3-speed frequency

converting installation.

Machines to be tested are installed on reinforced concrete rafts, set in concrete-lined pits in the test house floor, which may be observed in process of construction at the left in Fig. 1. Two sizes of raft are provided, measuring 13 by 11 and 19.6 by 11 ft. respectively, and each is about 5 ft. thick. The rafts are supported on 4-in. thick layers of cork, and pre-loaded compression springs are inserted between the sides of the pits and the rafts. The dimensions of the rafts have been chosen to enable different kinds of vibrations to be damped, and the springs, which are made up in



Fig. 2. Equipment in the standards room at the new Institute building includes this Leitz surface finish measuring instrument, which is equipped with a camera so that permanent records can be obtained

sets, are calibrated to assist in the damping action.

At present, the Institute employs some 340 people, and planned increases will bring the number up to about 380 by the end of this year. It is envisaged that 400 people will eventually be employed. Most of the extra staff will be recruited from technical schools and universities, at the age of 23 to 24, at a salary of £620 to £816 per annum, according to qualifications. After about five years, the salaries will normally rise to between £1,090 and £1,310, depending on ability. The cost of a single-course meal in the canteen, it may be noted, is about 2s. 8d., of which the Institute pays half, and members of the staff who live at some distance have cheap fare facilities on public transport.

Departments housed in the large building in the heading illustration include a drawing office which occupies almost the whole of the top floor, and has windows on each side, and artificial lighting by fluorescent tubes. On the fifth floor there is a large lecture room with equipment for the projection of still and moving films, and offices. Other offices are incorporated on the third floor, as is an extensive reading room with current issues of most of the world's technical journals concerned with machine tools and production engineering. A large translation department is also located on the third floor, with a filing system for records of articles which have been translated.

To date, some 60,000 articles have been translated into German, and for reference purposes there is a card index with a classification number, the date and name of the journal, and a short summary of the contents of each article. In addition, there is an index of subjects and authors. The translations are filed in the form of typescripts, together with photo-copies of the relevant pages to supply the illustrations. An average number of 4,000 pages of technical articles is translated yearly by a staff of about six people, several of whom are familiar with more than one language. The files also contain detailed reports on machine tool exhibitions held in all parts of the world, drawing attention to new design features which are often illustrated by means of the manufacturers' catalogues or leaflets.

Offices for engineering staff concerned with



Fig. 3. Work in progress in the temporary premises, occupied by the Institute until recently, included the checking of the surface finish produced at various spindle speeds on this fine-boring machine built by the Vogtland factory

specific fields, such as milling machines, occupy most of the remaining space above the ground floor. In the basement there are two temperature-controlled rooms in which testing and measuring equipment is installed for such purposes as checking of surface finish, and precision measurements of cutting tools. Equipment installed in this room includes the Leitz instrument shown in use in Fig. 2, for the measurement of surface irregularities, which enables readings to be made directly on a screen, or recorded photographically, if required. Other equipment includes a Zeiss toolmaker's microscope, a Hommell-Werke Perth-O-Meter surface finish measuring instrument, and a Talyrond (Taylor, Taylor & Hobson, Ltd.) roundness measuring instrument.

A small laboratory in the basement, staffed by two engineers and six technicians is equipped to produce electronic instruments of types which are not available commercially for special testing operations. There is also a well-equipped photographic dark-room in which copies of documents such as patent specifications, manufacturers' catalogues, and technical literature can be made for distribution to various Institute departments, and to factories outside. This dark-room is staffed by

women, and it may be noted that, in spite of the emphasis placed on their training for the engineering profession in communist countries, the only women on the technical staff are employed in the drawing office.

EXAMPLES OF WORK IN PROGRESS

Work carried out by the Institute, until recently in temporary quarters, has included the testing of the fine-boring machine shown in Fig. 3. Built by the Vogtland factory, of Stresemannstrasse 92, Plauen/Vogtland, this machine is one of a series of three and can be equipped with a maximum of three spindle heads which are carried on a bridge member in front of the hydraulically-powered table. Measurements were made of the surface finishes produced, and of machine vibrations and their effects, and the effects of external vibrations were also studied. Difficulties in obtaining sufficiently accurate measurements of small-amplitude vibrations have led to the development, by the Institute, of an instrument in which electrical induction is employed.

Investigations into the noise produced by various machines, including jig borers, and the effects on operators, are also undertaken. Limits for noise level, based on the work done by Slawin in Russia, are laid down for all new machines produced in East Germany. A great deal of work is concerned

with the testing of prototype machines before series production is started, and one such prototype is shown under test in Fig. 4. This hydraulically-operated guillotine is being checked, with the aid of electrical strain gauges attached to the beam, by imposing forces of varying magnitude, to determine the stiffness of the frame, and the suitability of various portions of the hydraulic system.

Built by the Zeulenroda factory in Thuringia, this guillotine is designed to cut plate up to 0.25 in. thick by 6 ft. 6 in. wide, and can be operated with a short stroke when sheet of less than the full width capacity is to be cut. The machine is being tested with the aid of selsyn indicators mounted above the beam and driven by flexible cables. The selsyns are connected to a photo-recording oscillograph, and provide measurements of the actual stroke length for each operation of the beam. At the same time, the pressure rise in the cylinders is recorded on a separate instrument, and affords an indication of the stresses imposed on the system.

Work carried out on vertical broaching machines of the type shown in Fig. 5, built by the John Schehr factory at Meuselwitz, near Leipzig, has included study of the vibrations occurring in the hydraulic oil in the main cylinder during broaching operations, and means of preventing such vibration from affecting the quality of the work performed. Operation of lubrication systems on new machines;

stiffness and rigidity of machine castings, such as milling machine columns; and the performances of plastics injection and extrusion machines, wire-drawing machines of new design, and hydraulic pump units, have also been investigated recently by the Institute.

WORK ON MACHINE DESIGN

As mentioned previously, the design and construction of each type of machine tool built in East Germany is studied by a department of the Institute and there is close collaboration between factory design teams and Institute engineers. This co-operation has been achieved during the six years that the Institute

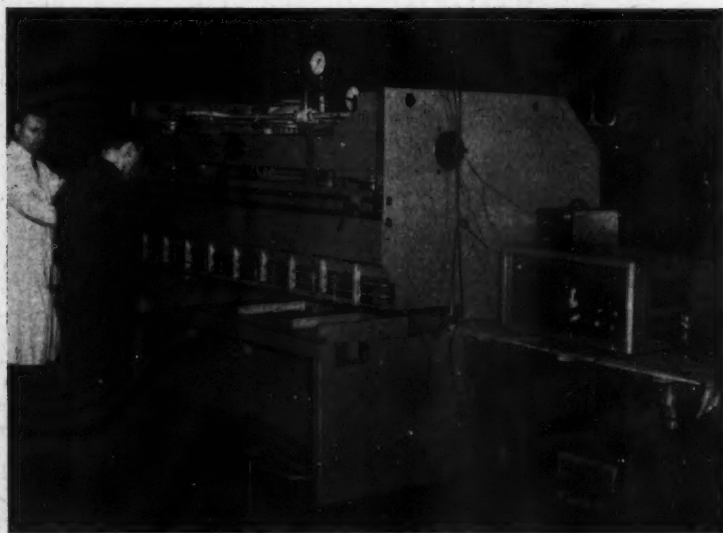


Fig. 4. Electrical strain gauges attached to the beam, and selsyns connected to the beam by flexible cables, are here being employed for checking beam stiffness and the functioning of the hydraulic system on this Zeulenroda guillotine

has been in existence, but it is stated that a further 15 years may be required before the system is developed to the degree envisaged. The reductions in the number of different machine tools built by the industry as a whole, for instance, were largely achieved through the Institute, which was responsible for deciding that certain machines should be dropped, and various new designs introduced.

These changes were largely carried through as a result of persuasion, despite the fact that many factories were reluctant to give up building well established designs and enter new fields. In this connection it should be noted that the Government has power to order such changes to be made, if necessary.

At present, new machine tool designs usually originate from the Institute, where specifications are prepared in accordance with known or anticipated manufacturing demands. Details, together with patent specifications and descriptions of any design features which might be incorporated, are sent by the Institute engineer responsible, to the appropriate factory. The specification includes such information as the range of spindle speeds and feeds, standard of accuracy required, and the total cost, and sketches of suggested arrangements may also be provided.

The factory design team then prepares drawings showing details of a machine which will fulfil the specification, and these drawings are sent to the Institute and to prospective users of the machine in East German factories. Meetings are held at the Institute or at the factory concerned, at which various modifications and improvements can be discussed, and after a period varying from 9 to 18 months, according to the complexity of the design, a prototype is built. With very complex designs, the period of discussion may be prolonged up to 3 years, and the building of a prototype, which is usually carried out by the factory involved, may take from six months to two years.

In the past, it has been the policy to show certain of these prototypes at the Leipzig Fair, before they have gone into production, but this arrangement has now been changed, and only machines which are ready for sale are exhibited. Testing of prototypes may be carried out at the factories in which they are built, or at the Institute if this course is more convenient. Any modifications to the design

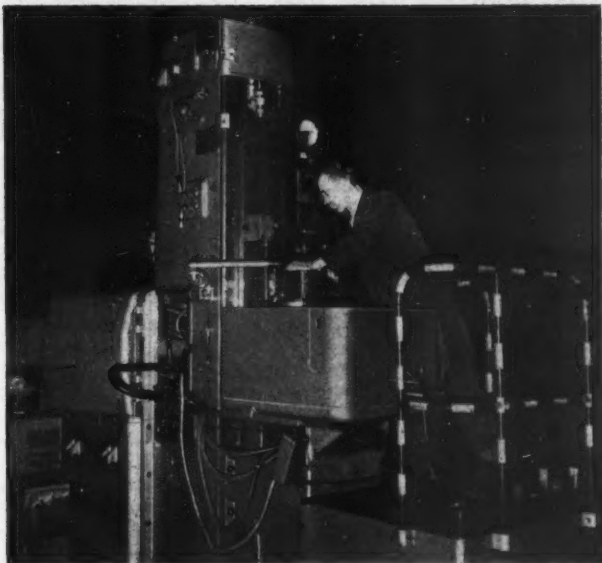


Fig. 5. Work carried out on this Schehr vertical broaching machine included a study of the effects of vibration in the hydraulic oil during broaching operations

which are found to be desirable during testing are incorporated in the machines when series production is started.

In a further article, to be published later, some details of the system of unit construction of machine tools, which is being introduced through the medium of the institute, will be given, also some examples of typical machines.

RISE IN CONSUMPTION OF ELECTRICITY. Speaking at the 13th British Electrical Power Convention held recently in Eastbourne, Sir John Pickles, B.Sc., M.I.E.E., chairman of the South of Scotland Electricity Board, in his Presidential Address, stated that since the electricity supply industry was nationalized in 1947, annual sales had increased from 36,000 to more than 100,000 million units. He forecast that the present consumption would be doubled by 1970, and suggested that the 1970 figure might again be doubled by 1980 or by 1985 at the latest.

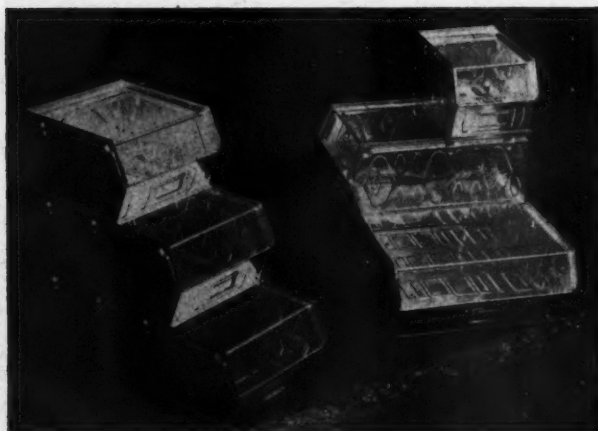
As between 1947 and 1961, the number of consumers had increased from 12 million to 17 million and the annual consumption per head from 700 to more than 2,000 units. In the same period, the capacity of installed generating plant has risen from 13,000 mW. to about 32,000 mW.

Spacesaver Unit Storage System

Bradley & Co., Ltd., Albion Works, Bilston, Staffs., have recently developed the Spacesaver unit storage system, and the range of equipment which is available includes containers of five sizes, from 13 by 12 by 8 in. high to 25 by 18 by 8 in. high. Made from steel, each container has front and rear cross-bars at the top, to facilitate movement by hand or fork truck, and can be supplied with a hot-dipped galvanized finish or stove enamelled in one of a wide range of colours, as required.

Containers of successively smaller sizes can be stacked crosswise and in line, as here shown, and when a number of units of the same size is stacked in line, the inclined open portion at the front of each allows observation of the contents and permits loading and removal of parts without the need for disturbing the arrangement. To facilitate the latter operations, a chute is available which may be readily attached to the front of a stacked container, also a clip whereby a container can be suspended from the front of a stacked unit. Longitudinal dividing plates can be supplied, which are located by separate slotted strips, and to protect the contents from dust and dirt, removable cover plates and transparent hinged front flaps can be provided.

Shelf units of two sizes, to accommodate all



Spacesaver containers of successively smaller sizes can readily be stacked, as here shown, and when units of the same size are stacked, parts are loaded and removed through inclined openings at the front

containers in the range, are available with hot-dip galvanized or a metallic grey finish, and provision is made for readily setting a single shelf to the mid-position, to receive containers, or a number of shelves to other positions, as may be required when storing loose components. A safety bolt assembly is available for attachment to any cross-bar of the unit, to prevent the accidental complete withdrawal of a container. Loads of $\frac{1}{2}$ and 6 tons can be supported by individual shelves and the entire unit, and a number of units can be stacked without the need for bolting. Clips can be provided for fastening together adjacent stacks, when units are built to a considerable height. In connection with large installations, savings may be made by the use of bridge shelves which may be readily arranged between two stacks of units, and the latter can be connected by tie bars, if a high degree of rigidity is required. Brackets can be supplied whereby a mezzanine gangway can be supported directly by the stacked units. Cover plates are obtainable for the units, which may be readily converted into trolleys by adding castors.

TIN IN CAST IRON. In the annual report for 1960 of the International Tin Research Council, it is pointed out that tin in cast iron is a strong pearlitic promoter. The addition of about 0.1 per cent of tin to either flake or nodular cast irons will give a fully pearlitic structure without producing massive cementite. Casting and testing of different irons with and without tin additions continued during the year, and it was found that flake iron was still free from massive cementite even when the tin content was considerably in excess of the recommended amount.

At one American foundry it is stated, where tin is used as a ladle addition, it has been found that it rapidly disperses throughout the molten metal, which has a fine pearlitic structure when cast. Variations in hardness are considerably reduced by the addition of tin, and the material is particularly suitable for such applications as automobile clutch-plates, in which uniformity of texture and smoothness in wear are important.

DIE CASTING SUPPLEMENT

The Gating of Aluminium Die Castings

By H. K. BARTON

THE GATING of aluminium alloy die castings determines, more than any other die design factor, their surface finish and structural soundness. Poor gating practice results in high scrap rates, and it may be assumed, with a fair degree of confidence, that when a component is produced with a high percentage of rejects, the quality of those castings that pass inspection is likely to be only marginally acceptable. Because of the wide diversity of form, section and complexity encountered in die cast components, the selection of an appropriate form of gate for a specific casting must necessarily be largely empirical. It is therefore difficult to generalize as to the merits of particular methods of gating, since even minor modifications in the form of the casting that is to be produced may dictate considerable changes in the position and form of the gate.

Although much attention has been paid in recent years to the gating of die castings, it has, in general, been concentrated on the determination of the required cross-sectional area of the gate rather than on its optimum position; the effects of runner form, volume, and plan area upon the efficiency of the actual gate; and the modifying effects of overflows upon the flow from the gate through the cavity. These latter factors are, however, intrinsically of greater importance than the mere cross-sectional area, for whereas the size of the gate can be progressively increased without any difficulty, assuming that the feeding method is in general satisfactory, the modification of a runner that is poorly designed may entail much welding and re-cutting. Unfortunately, these basic criteria are not amenable to reduction to a formula or a graph, and runner layout, as such, still depends upon the cumulative experience of the designer.

There is no "ideal" position for the gate of any die cast part—most castings could best be fed from a point on the under-side near the centre of mass—and any position that is chosen will have some unsatisfactory features. The main value of the designer's experience is that it enables him to rule out, immediately, the totally unsatisfactory gate positions, and to mitigate the shortcomings of the least unsatisfactory position by the careful

choice of runner form and the judicious use of overflows. Guidance that can most usefully be given to the less experienced designer, therefore, is of an essentially negative character. In other words, one can point out those features of gating practice which—although they are frequently seen in use—tend to result in poor quality castings and a high scrap rate.

In the present discussion, we are wholly concerned with the production of aluminium alloy die castings by conventional means. Vacuum techniques, although demanding just as much attention to correct gating practice, involve considerations that are better explored separately. Only cold-chamber methods are, of course, involved, and the gating features examined may, except where there is an indication to the contrary, be taken to relate to dies operating on modern machines equipped to give slow initial plunger movement, a variable-speed filling stroke, and an intensified final pressure.

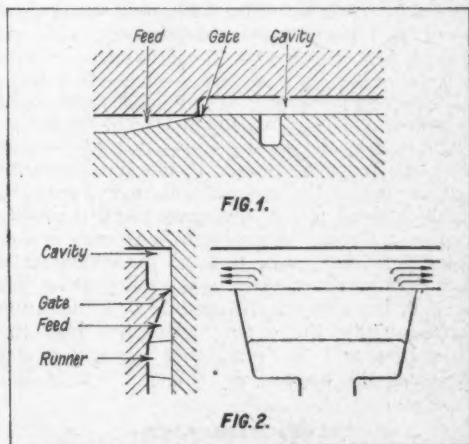


Fig. 1. Typical gate form for a flat casting
Fig. 2. When feeding into a heavy flange, metal tends to flow preferentially around the edge of the casting

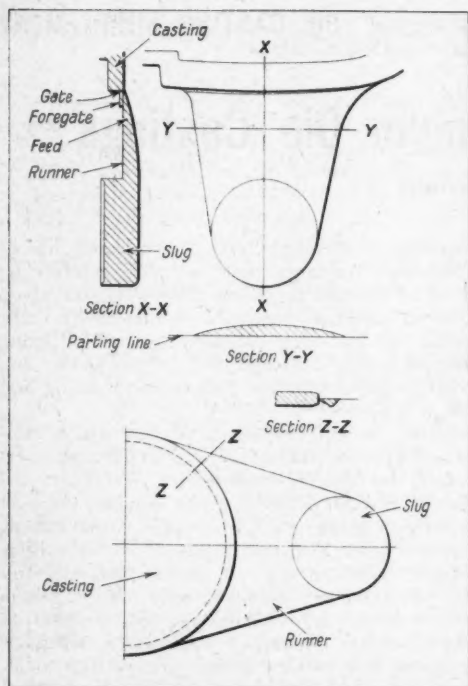


Fig. 3. A spreading runner feeding into a comparatively straight edge. The terminal flares, and the reduction of runner depth toward the sides, are particularly unsatisfactory

The major difficulty in producing sound die castings is not in getting the metal into the cavity, but in getting the air out of it. In cold-chamber machines, much of the air in the shot-sleeve, as well as that in the runners and cavity, must be expelled ahead of the advancing metal if solidity is to be achieved. Accordingly, a primary aim of gating practice must be to avoid the sealing-off of vents and overflows early in the filling phase, for once this has occurred the residual air is inevitably trapped within the casting. However high the final pressure, it can only compress—not eliminate—this trapped air.

GATING ARRANGEMENTS WHICH CAUSE EARLY SEALING OF CAVITY VENTS

If, as is often the case, a casting is so gated that metal strikes the die surface at a very oblique angle (Fig. 1) and spreads in a thin stream across it, much of the periphery of the component is sealed

off before more than a small proportion of the metal has been injected. The same applies when a thin-walled casting has a bead or flange of thicker section all round it. Metal flows preferentially along the thick section (Fig. 2) and seals off all the parting-line vents before the thin-walled areas are completely filled. The fault is accentuated in both instances when runners of a spreading or "fish tail" form are adopted.

Examples of such runners are seen in Fig. 3. Their effect is to project a fan-shaped wavering jet into the cavity and, as they are frequently cut in such a way that they diminish in depth at each side (section Y-Y), flow may be extremely unstable. Metal entering the runner during the first part of the plunger stroke solidifies in the wedge-shaped extremities, so that only the central portion of the gate is initially effective. The hotter metal that follows cuts back into the chilled metal at the sides, with the result that the effective cross-section of the gate is again increased during the filling period. Control of the direction of flow within the cavity is consequently very poor, and the pattern of cavity filling varies greatly with die temperature, which determines to what extent the initial choking of the gate extremities occurs.

Some choking takes place at the ends of gates even if the section of the runner—or rather of the tapered feed—is held constant. Again, this effect is most marked with the spreading type of runner, since cold metal that has risen slowly from the shot-hole during the first part of the plunger stroke is forced outwards to the sides of the feed when the flow meets the resistance of the gate constriction. This condition can only be avoided by adopting converging, rather than spreading, runner layouts, or by extending the runner channels laterally beyond the ends of the gate to form pockets into which the chilled metal is projected.

ADVERSE EFFECTS OF CURVED RUNNERS

In practice, these two features are often advantageously combined, but before discussing examples of such arrangements it is desirable to consider further unsatisfactory types of runner layout. A flagrant example is the carrying of a runner in sweeping curves from the shot-hole to the gate, a practice to which many draftsmen are much addicted. One such layout, seen recently on a die undergoing try-out, is sketched in Fig. 4.

The die in question has two "handed" cavities for a component of approximately trapezoidal form, of such a length that the lower ends of the cavities are about level with the top of the shot-hole. As may be seen, the central portion of the runner follows a curve concentric with the shot-hole, and

reverse curves continue the channels up to the fish-tailed feeds. A section through the slug is shown on the left, and it will be noted that the runner is fed from a circular depression—the depth of which is a little greater than that of the runner itself—located opposite to the shot-hole.

Such a layout has many unsatisfactory features, the most adverse being the extent to which air is initially trapped in the runner, and subsequently carried into the cavity with the metal. This trapping occurs because the metal first forced up out of the shot-sleeve is projected around the outside curve of the central portion of the runner, as indicated in Fig. 5, until it reaches the points x , where it leaves the surface tangentially to follow the outside curves of the outer ends of the runner. Not until the tapered feed sections have filled with metal backing up from the gates does the metal from the shot-sleeve begin to flow at "full bore."

Because of the velocity gradient across a curved channel—the metal necessarily flows faster on the side having the greater radius of curvature—turbulence in a curved runner is very marked. It is clear that this principle is not well understood, because one of the commonest reasons put forward to justify this type of runner is that "it makes for smooth flow." The contrary is in fact the case, and the vorticity generated as the metal swings round the curve causes the ingestion, in the turbulent mass, of the air previously trapped. Unlike air caught up in the metal flowing along a straight channel, this air does not travel with the flow in relatively large bubbles, but is broken up into a great number of smaller ones. Moreover, because of the tendency for stagnant zones to be formed along the inner curves—the well-known "oxbow" effect—the ingested air is not carried into the

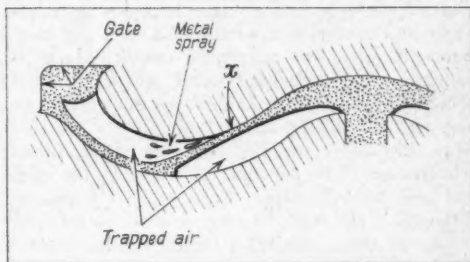


Fig. 5. Flow through the curved runner at an early phase

cavity all at once, but continues to enter with the metal throughout the greater part of the injection phase.

Consequently, with runners of this kind (and much more tortuous runner channels are not uncommon) it is extremely difficult to avoid gross porosity in the component. Wherever possible, therefore, runner channels should be straight and of unvarying cross section, and where a change of direction is necessary, there should be no fairing or blending of the angles of the junction. If, for example, a runner must be turned through a right angle, it should not be milled to a radius as indicated on the left in Fig. 6, because this form results in air being trapped by the metal.

A change of direction should instead be made by carrying the main runner well beyond the point at which the turn is required, and cutting the branch runner either at right angles to it, as indicated at the right in Fig. 6, or at a slight negative angle, as in Fig. 7. The choice between the two forms depends upon the degree of pressure relief that it is desirable to incorporate in the runner system. In either case, the metal flowing along the main runner continues in a straight line into the runner extension, and not until this portion is substantially filled—and the back pressure consequently rises—does any quantity of metal pass into the branch runner.

The metal in the runner extension, of course, contains a large quantity of trapped air, which acts as a pneumatic shock-absorber. Initially, therefore, metal enters the branch runner at relatively low velocity, so that air is easily forced ahead of it through the gate, and it is not until the branch is running full bore that the whole

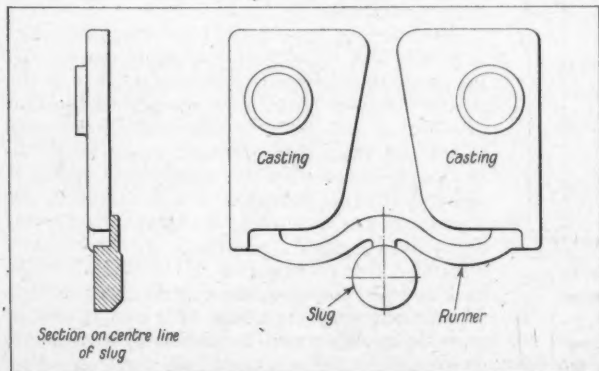


Fig. 4. This type of runner is wrongly thought to inhibit turbulence

thrust of the injection plunger becomes operative. When this condition is established, and the metal begins to move with maximum velocity along the branch, a velocity gradient is certainly set up across the branch near the junction. By this time, however, virtually all the air carried in from the shot-sleeve has been expelled, so that the resulting turbulence is of no account. Indeed, the net effect may well be favourable, since any air remaining entrained in the metal is subjected to considerable centripetal stress and the bubbles move preferentially towards the stagnant or low pressure zone at the inside of the curve (Fig. 8).

It may appear at first sight that the same phenomenon—the establishment of a velocity gradient across the stream where it changes direction—has first been adduced as a cause of air being carried into the cavity, and then as a factor preventing air from being carried in. There is, however, no inconsistency. With curving runners static air is trapped when metal gets ahead of it, but when sharply angled runners are adopted, the static air is pushed through the channel ahead of the metal, and it is only air already entrained in the metal stream that is in question. Moreover, the angular

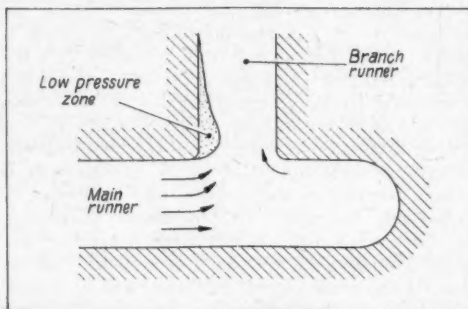


Fig. 8. The angular momentum of the metal flowing round a sharp bend induces a low pressure zone, as shown

velocity of the metal is far greater when a sharp corner must be turned, so that the centripetal force upon the air bubbles is much increased.

DISADVANTAGES OF THIN GATES FOR ALUMINIUM

Spreading runners are usually justified on the grounds that by widening the feed section as its depth diminishes, the metal passage is not constricted progressively as the gate is approached. On this subject there are several comments to be made. The first is that the use of very wide and thin gates is a "carry-over" from zinc die casting practice where, although not desirable, it must in general be tolerated because it facilitates trimming. Under the very different conditions obtaining in the cold-chamber die casting of aluminium alloys—both metal temperature and injection pressure being much higher—shallow gates are much more undesirable.

When a thin gate is used in conjunction with high injection velocity, the metal is sprayed into the cavity in a pulsating, wavering stream. If this stream impinges immediately upon a core surface, overheating and erosion ensue, while if the metal is able to travel some distance tangential to the surface, as indicated in the upper sketch in Fig. 9, air and residual lubricant are carried with the stream into the area where the surface flow breaks down and the metal "puddles." As the turbulent mass thus formed increases in volume and moves back towards the gate, there is little opportunity for air and vapour once trapped to escape, and the unstable metal stream is continually carrying in more air.

To produce consistently sound aluminium alloy die castings, it is desirable to provide a gate of a size and form that will cause the metal to puddle

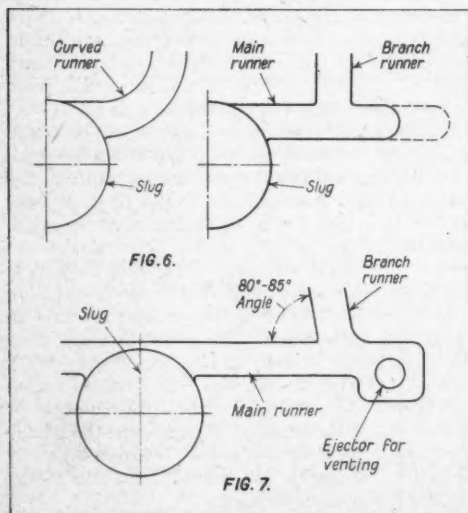


Fig. 6. When the direction of flow must be changed, the runner form on the right is preferable to that on the left

Fig. 7. To retard flow along the branch runner until the main runner is flowing full bore, the former is set at a slight negative angle, and a terminal "pressure relief" is cut at the end of the latter

—that is, to form a mass filling the whole cross-section of the cavity—as near to the gate itself as can be ensured (lower sketch in Fig. 9). This arrangement has many advantages, the foremost being that metal passing the gate (once the puddle has filled back to the gate) cannot entrain additional air. Secondly, the efflux of the stream into the already injected metal reduces its velocity and modifies its impact upon adjacent core surfaces. Thirdly, the heat resulting from the loss of kinetic energy is carried, by reason of the strong turbulence immediately around the gate, outward into the spreading puddle.

As will be evident, the velocity of the metal at the advancing edge of the puddle is very much less than that of a free metal stream projected through the cavity. As the puddle increases in volume, the size and form of the gate cease to exercise a direct effect upon the direction and velocity of the metal advancing through the cavity and the gate can

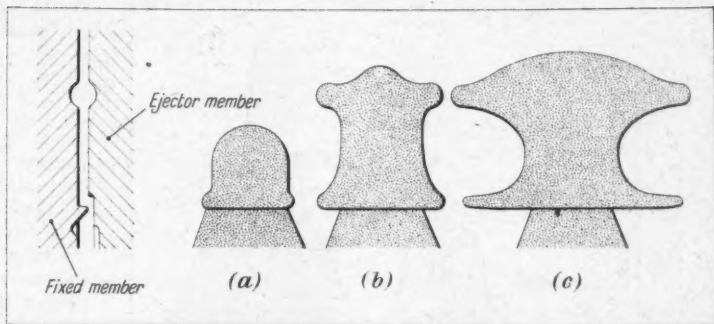


Fig. 10. Metal flow in relation to a transverse enlargement of the section

accordingly be considered as a point source.* The manner in which the advancing edge of the puddle spreads is primarily determined by variations in the thickness of the cavity cross-section and the local temperature of the die surfaces.

Provided that the section variations are not such that the metal can spread preferentially around the periphery of the cavity (and this can largely be prevented even in thick-rimmed dish-shaped components, by correct gating) venting at the parting-line remains effective throughout

virtually the whole of the filling phase when puddle feeding is adopted. Thus, although velocity is lost—and heat gained—in the vicinity of the gate instead of remote from it as in free stream feeding, the influx rate is not appreciably reduced since the freer venting allows the air being compressed by the expanding puddle to escape more readily from the cavity and so lowers the back-pressure. Similarly, lubricant vapours, in the main, are blown out of the cavity ahead of the metal, and solid lubricant residues are not scoured from the surface and caught up in the metal, as happens when high-velocity and partly atomized jets play tangentially across a cavity surface.

The locations of gates and overflows are highly critical even when puddle feeding is employed, for since the metal advances preferentially along the lines of least resistance—that is, generally, through the largest

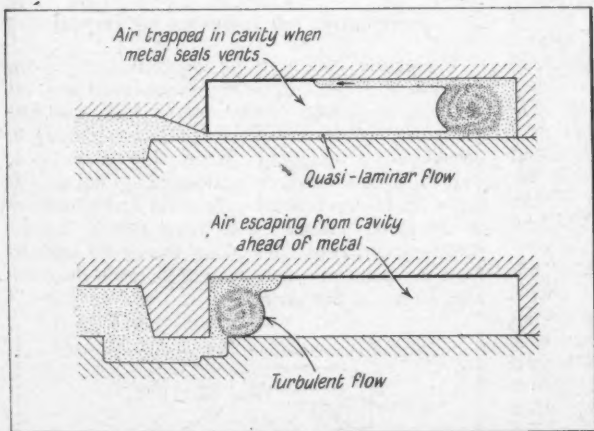


Fig. 9. Flow through a thin gate into a heavy-section cavity tends to result in the formation of a shell which then becomes filled-in from the far end. A heavier gate, placed so that the jet travels only a short distance before striking the die wall (lower sketch), results in a quick cessation of the undesirable quasi-laminar flow and the metal thereafter advances across the full width of the space between opposite die walls

* Barton, H. K., "Effect of Cavity Proportions upon Metal Flow," MACHINERY (London), January 25, 1957.]

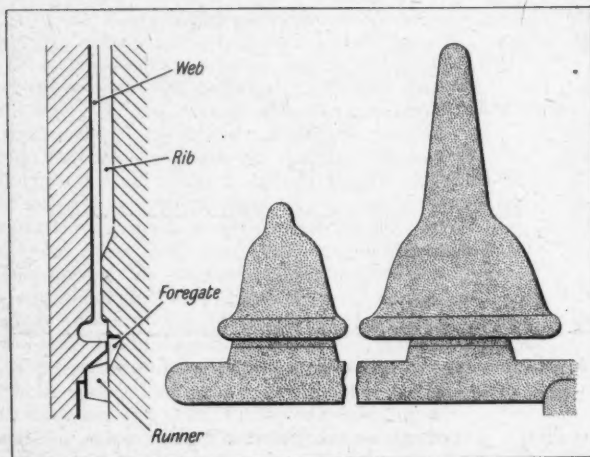


Fig. 11. The effect of a rib or bead placed in the direction of flow

sections—air locks are formed if unfilled areas are cut off. Such an air lock may occur, for example, if the metal is able to advance along a pair of heavy rib impressions and merge at the far end.

EFFECT OF RIBS ON METAL FLOW IN THE CAVITY

The orientation of ribs and other features involving local changes of section, in relation to the gate, is accordingly of primary importance. If the advancing edge meets a heavy rib section transversely, as in Fig. 10, the effect is to retard, momentarily, the forward movement as metal flows laterally along the rib, but the sideways movement through the thin section on the near side of the rib continues. Feeding into the rib thus proceeds on a widening front, to increase the lateral flow rate within the rib and straighten out the advancing metal front in the thin section on the far side of the rib. This effect is indicated by the sketches *a*, *b*, and *c* in Fig. 10.

If the advancing edge, moving through a thin section, encounters the end of a heavy rib cavity disposed radially, as in Fig. 11, flow again occurs preferentially along the rib, but the outward flow from the rib on both sides increases with the length of the rib filled, as shown in the figure. Whether one type of flow is to be preferred to the other depends upon the overall form of the component, and cannot be arbitrarily determined. The actual

extent to which ribs and similar features modify flow is, of course, controlled by their shapes and cross-sectional areas.

In order to prevent flow along ribs resulting in air-locks, it is desirable that the rib section should be slightly thinner than the adjoining web, and this relationship is also to be preferred on other grounds. When heavier ribs are necessary for structural reasons, they should preferably be faired off into the wall at both ends, in the manner indicated in Fig. 11, rather than carried to the edge of the component. Such fairing is particularly desirable if the edge of the casting has a heavy bead into which the far end of the rib would feed. However, these are points for the consideration of the product designer rather than the die designer, and the latter can obtain a satisfactory filling pattern even for components embodying unsatisfactory features by careful attention to gating and feeding.

HEAVY GATING FOR ALUMINIUM DIE CASTINGS

For puddle feeding to be achieved, heavy gating is essential. For it to be effective, correct positioning and orientation of the runner, feed, and gate are equally necessary—the two factors cannot be considered in isolation. Wide, thin gates, as in Fig. 12, even if correctly positioned, do not give an initial build-up of metal within the cavity adjacent to the gated portion. The metal merely changes direction and runs back along the cavity surfaces from the point of impingement, blocking the vents well ahead of the main fill.

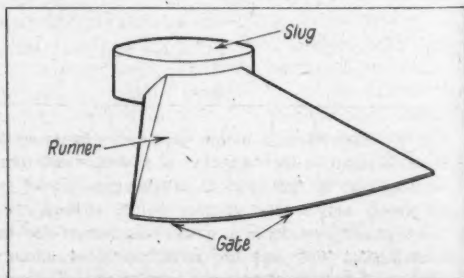


Fig. 12. Gates of this type are seldom satisfactory for aluminium alloy die castings

Fig. 13. Direct (Polak-type) feed into the web of a casting

Fig. 14. Feeding into a boss is more frequently adopted

It must be remembered that the use of a gate—in the sense of an imposed constriction of the flow where the runner joins the casting—is by no means essential to the production of an acceptable die casting. Many components, even of thin section, are satisfactorily produced on Polak-type machines by direct feeding—that is, with the tapered sprue-hole opening directly into the cavity as in Fig. 13. The sprue metal is cut off short and, if necessary, the base is ground flush with the remainder of the casting surface. It is, however, common for designers well experienced with such machines to

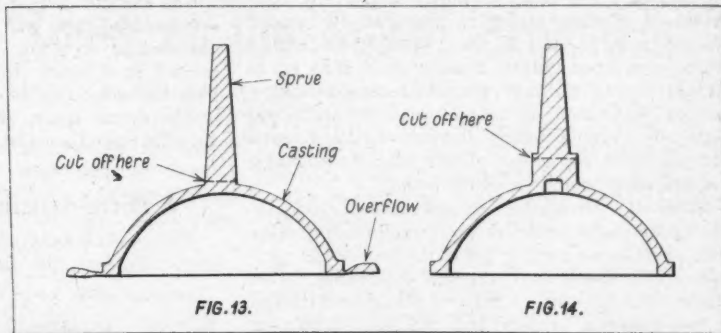


FIG. 13.

FIG. 14.

revert to outside gating for a component like that shown, whereas they would have no hesitation in gating into even a shallow boss, as in Fig. 14. Operationally, of course, there is no difference whatever between the two castings. The solidity of Polak sprues is noteworthy and the point at which they are subsequently cut from the casting is of no importance from the cavity-filling standpoint.

There is thus no disadvantage to heavy gating apart from the increased difficulty of separating the runner-metal from the casting, and since many aluminium die castings must be band-sawn (see Fig. 15) even if wide and relatively thin gates are provided, major objections can only arise when the gate form is such that all the runner metal cannot be removed with a band-saw. Such a situation arises, for example, when an upward gate into the rim or flange of a component is adopted, on the lines indicated in Fig. 16. When a part gated in this way is bandsawn, a solid stub is left on the underside of the casting. For this reason, designers frequently avoid what, for many components, would be the best type of gate.

Nevertheless, it is always unwise to sacrifice casting quality for ease of trimming, and there are welcome signs that die casters are becoming more willing to mill runners from the casting instead of sawing them off. In the case of parts gated as shown in the figure, it may be an advantage to mill the whole flange surface, thus eliminat-

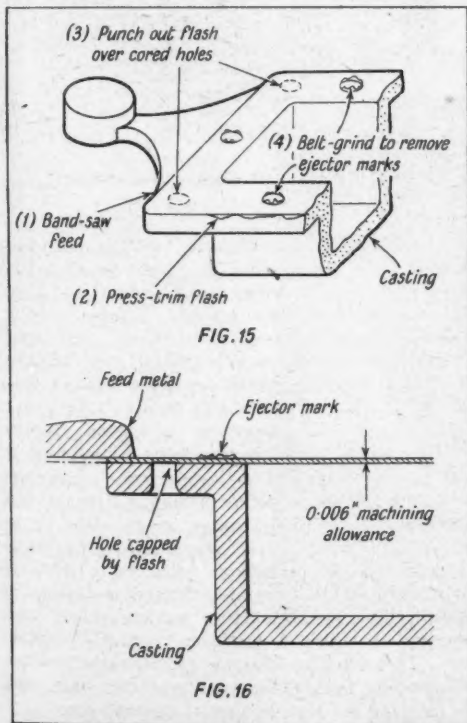


FIG. 15

FIG. 16

Fig. 15. Four secondary operations are required on this die cast aluminium housing
Fig. 16. All four operations may be replaced by taking a milling cut all over the flange surface as shown. Milling also corrects distortion and gives improved dimensional accuracy since compensation is made for variations in flash thickness by the depth of cut taken

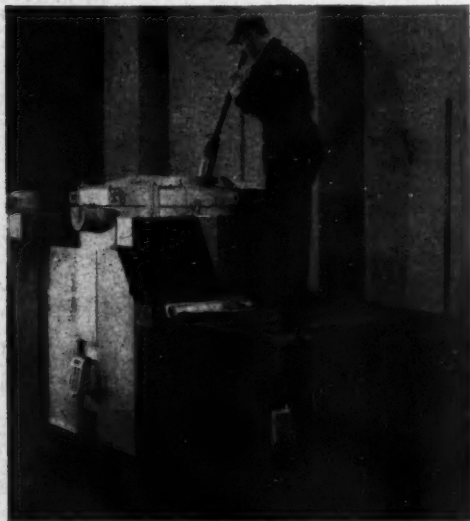
ing not only the band-sawing, but also any belt- or wheel-grinding operation required to remove ejector marks. On modern rotary-table equipment, with fixed cutters rotating at speeds up to 10,000 r.p.m., milling operations of this nature can be performed on several hundred parts per hour. For profile milling, to remove runner metal and fins from the edges of irregular die castings, outputs may be only slightly lower.

There is, therefore, no insuperable obstacle today to the gating of die castings in aluminium alloy with primary regard for the soundness of the casting and the speed of production achievable, rather than ease of trimming. Ease of filling, and control of the direction of flow and the rate of fill, are then the factors with which gating and runner layout are essentially concerned. Here they have been considered only in the broadest way, but at a later date it is proposed to deal with specific runner layouts and gating methods in some detail.

Morgan Type BT. 1300 Basin Tilter Crucible Furnace

The type BT. 1300 basin tilter crucible furnace shown in the illustration, has recently been placed on the market by Morgan Crucible Co., Ltd., Battersea Church Road, London, S.W.11, and is similar in design to the company's type BT. 380 and type BT. 500 furnaces.

This new furnace is particularly intended for

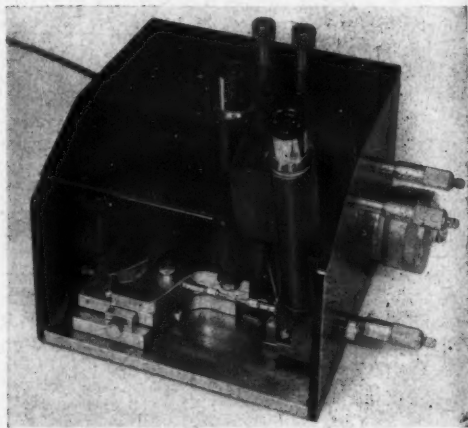


Morgan type BT. 1300 basin tilter crucible furnace

use in the die casting industry for supplying bale-out furnaces, and will take a maximum charge of aluminium, weighing 1,300 lb., which can be melted in 1 hour. It has a low platform, and a large-diameter crucible, which facilitates charging bulky metal scrap, and provision is made for variable speed control of the tilting motion.

A Micro-tensile Testing Machine

Techne (Cambridge), Ltd., Duxford, Cambridge, have acquired the manufacturing rights for the



Testing machine for single crystal whiskers

bench-mounted micro-tensile testing machine shown in the figure, which has been developed by the Research Laboratories near Cambridge of Tube Investments, Ltd., The Adelphi, London, W.C.2, for testing single crystal "whiskers" and other items which may have a length of only 0.5 mm. (0.02 in.), and cross-sectional areas ranging from 10^{-3} to 10^{-7} sq. mm. (2×10^{-3} to 2×10^{-10} sq. in.).

The machine incorporates a torsion balance which enables loads ranging from 1 mgm. up to 400 gm. to be applied to the specimen. Increases in length of the specimen ranging from a few Angstrom units up to 15 mm. are detected by an auto-collimator, and are measured, usually to an accuracy of 100 Angstrom units, by a sensitive micrometer, which operates through a system of levers. In certain instances readings have been repeated to within 5 Angstrom units (0.00000002 in.). The machine can be readily arranged for compression testing, for testing of thin films, and for carrying out tests in special atmospheres.

Machine Tools at the Soviet Exhibition

By R. E. GREEN, Associate Editor

An article published in MACHINERY, 99/161—19/7/61, described the two largest Russian machine tools on view at the Soviet Exhibition, which is to continue until July 29. Some other machines displayed are here considered.

PROGRAMME-CONTROLLED FINE-BORING MACHINE

The type 2706 fine boring machine shown in Fig. 1 is built by the Odessa radial drilling machine works, and is of conventional construction with bridge castings to carry the spindle heads and a hydraulically-operated table for the fixtures. Each bridge member can accommodate up to four spindle heads—according to width—from the range of four different sizes, and bores from 0.39 to 7.87 in. diameter can be machined. Spindle speeds of 1,000, 2,000, 3,000 and 5,000 r.p.m. are available, the heads at each end being driven by separate motors, which are of 3.75 h.p. on the machine shown. Hydraulic power is provided by a motor-driven pump, housed in the base, and the table feed can be varied between 0.39 and 38.38 in. per min.

Normally the machine operates on an automatic cycle which includes rapid traverse towards the tools at one side, movement at the set feed for boring, and rapid return to the central position, unloading and reloading of fixtures at the other side of the table being carried out during this time. Alternatively, the table may be caused to travel first to one set of tooling for rough-boring, and then to the other set for finishing, or to move in the two directions in succession for operations on different bores. All these movements are selected by the insertion of contact plugs in sockets in a board at the

rear of the machine, as seen in Fig. 2. This board is normally covered by a glass-panelled door, and it provides for the selection of a maximum of 10 successive movements in any one machine cycle.

The rows of sockets are labelled and they provide for movements of the table in either direction, at rapid or feed rates, starting and stopping of the spindles at either end of the machine, and a dwell period. There is also provision for stopping the machine at the end of the cycle, and for repeating the cycle from a particular point, for instance, for reboring a hole to allow for spring in the tool, or for indexing a fixture.

On the machine shown, the fixture is designed to hold two cast iron diesel engine fuel pump components, in each of which four holes of approximately 1 in. diameter are to be bored, to form the pump cylinders. These castings are located on the vertical face of the fixture, at the right in Fig. 1, by means of dowels which enter holes near each end, and are secured by three lever-type clamps, held on the rams of horizontal hydraulic

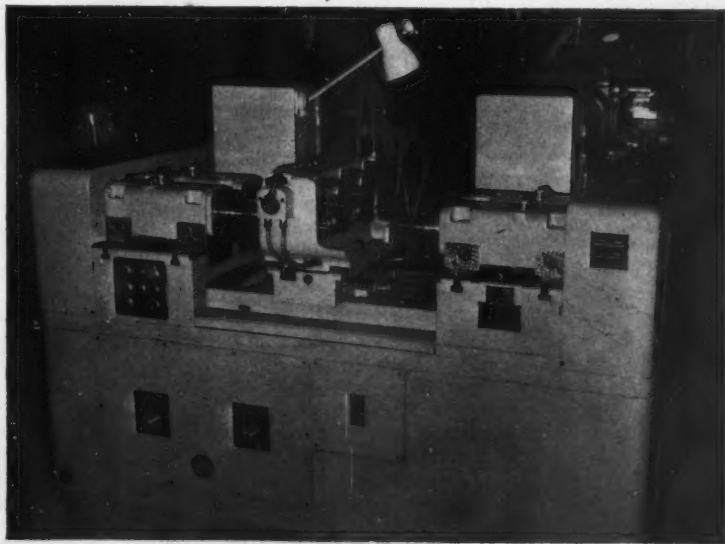


Fig. 1. General view of the type 2706 programme-controlled fine boring machine built by the Odessa radial drilling machine factory, which can be fitted with a maximum of four spindles at each side of the central table

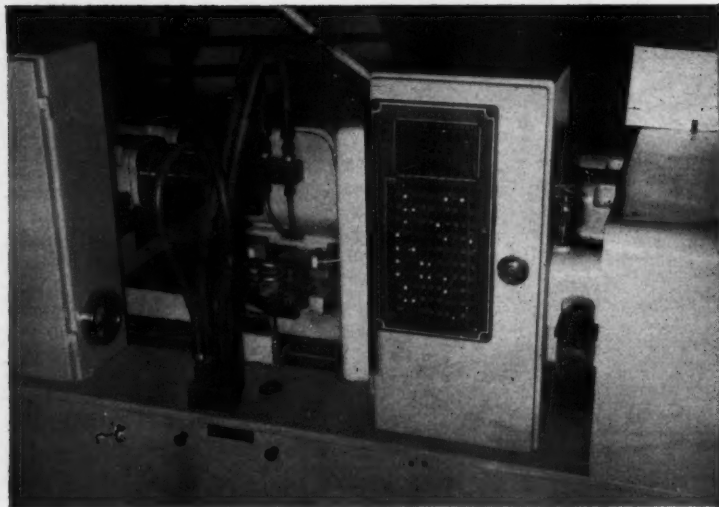


Fig. 2. The cycle of the 2706 fine borer is controlled by means of this socket board into which plugs are inserted to complete electrical circuits for the operation of relays and solenoid valves in the hydraulic system

cylinders in the fixture. These rams have cam grooves which are engaged by fixed pins so that the clamps are turned through an angle of about 90 deg. as they are retracted and advanced, to carry them clear of the castings for loading and unloading.

Force is applied by the clamps to the ends of the castings, at the dowel pin positions, the centre clamp being fitted with a pivoted beam which engages the adjacent ends of two castings. The fixture is carried on a slide, supported on guideways arranged at 90 deg. to the direction of table traverse, and it is moved in succession to four positions, for the boring operations, by a hydraulically-operated system. After the work has been loaded and clamped, the automatic machine cycle is started by pressing a button at the front of the machine, and the fixture is then moved to the limit of its travel towards the front of the table.

The table is next moved to the left at rapid traverse speed, the left-hand spindles are started, and as the work approaches the tools, the feed is reduced to the pre-set rate. At the end of the rough boring operation, the spindles are stopped and the table is rapid-traversed to the right, where a similar sequence is followed for the finish-boring operation. As the table subsequently returns towards the central position, a pawl on a bracket fixed to the machine bed at the rear turns an 8-tooth pinion on the end of a shaft projecting

from the rear of the fixture guideway casting. This pinion is held in position by a spring-loaded grooved detent, and its shaft also carries a collar with flat surfaces on opposite sides.

As the gear is turned, the circular portion of the collar moves into a position in which it pushes downwards on a nearly horizontal, centrally-pivoted lever. The other end of this lever is thus raised, to push up a plunger in a valve block, and thus change the direction of the oil supply to the indexing cylinder so that the fixture moves towards the rear. Travel is limited by the first of four stops on the shaft

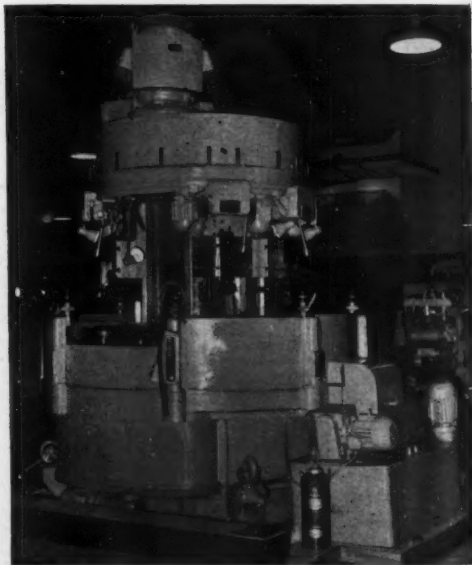


Fig. 3. On this type 1283 8-spindle vertical chucking automatic, control of the rapid traverse and feed motions of the slides is effected by means of punched cards, fitted to drums which are turned as the slides move

carrying the gear, and the fixture is thus located in the required position for rough- and finish-boring of the second hole in each casting. The machining and indexing cycles are then repeated for the remaining holes, and the machine is eventually stopped automatically for unloading, with the table central and the fixture at the rear.

EIGHT-SPINDLE VERTICAL AUTOMATIC CHUCKING LATHE

The type 1283 8-spindle vertical, automatic, chucking lathe, shown in Fig. 3, is an improved version of an established design for the range 4-, 6- and 8-spindle machines of this type, made by the Krasnoi Proletarii factory in Moscow. The

machine has a nominal capacity for blanks up to 12.6 in. diameter, but larger components can be handled if necessary. There are 35 spindle speeds ranging from 50 to 800 r.p.m., which are obtained with change gears, and each spindle can be driven at a different speed if required. Power is supplied by a main motor of 134 h.p.

For indexing the table there is a Geneva mechanism, and it is located with the aid of wedge-shaped projections on the periphery, which are engaged by a V-grooved block advanced by a hydraulic cylinder. By arranging the locating mechanism on the table edge, it is claimed, maximum accuracy of positioning is ensured. Hydraulic pressure, supplied from a pump unit driven by a motor of 13.4 h.p., is also employed for the operation of the chucks, and for relieving the weight of the table during indexing, also for the operation of the spindle-driving clutch.

Each of the seven machining slides has a separate rapid-traverse motor, which is controlled during setting operations by a joy-stick lever at the side of the unit above. A range of feeds from 0.0012 to 0.139 in. per spindle rev. is obtainable with change gears, and the feed rate can be doubled during the cutting traverse, if required. Control of the points at which the changes are

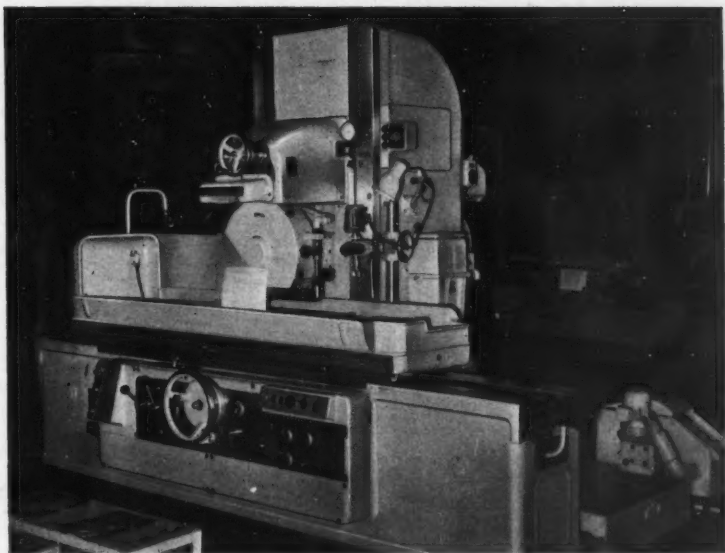


Fig. 4. This type 3722, horizontal-spindle surface grinder, built by the Moscow grinding machine works, will accommodate work up to 15.75 in. high above the table, and can be operated on an automatic cycle

made from rapid traverse to the feed rate, and from one feed rate to the other, for each slide, is effected by means of a flanged brass drum in a housing above the slide. This drum is connected to the slide so that it is turned as the slide moves, and it is fitted with a punched card.

Electrical contacts adjacent to the drum periphery rest on the card surface, which acts as an insulator, but when a hole in the card passes one of the contacts, of which there are three, an electrical circuit is completed to a relay which stops the fast traverse motor or operates a magnetic clutch to change the pre-set feed rate. Each slide has a total traverse of 13.78 in., for turning or boring operations, and special slides operated through racks and pinions can be fitted for facing work. Multi-spindle drilling heads and milling units can also be fitted to the machine if necessary. At the exhibition, the machine is set up for operations on commercial vehicle engine flywheel blanks, but no actual cutting is being done.

With a total weight of 19.5 tons, the machine occupies a floor space of 11 ft. 7 in. by 11 ft. 1 in., and is 12 ft. 10 in. high.

Built by the Moscow grinding machine works, the type 3722, horizontal-spindle surface grinder, shown in Fig. 4, closely resembles the type 3A 732,

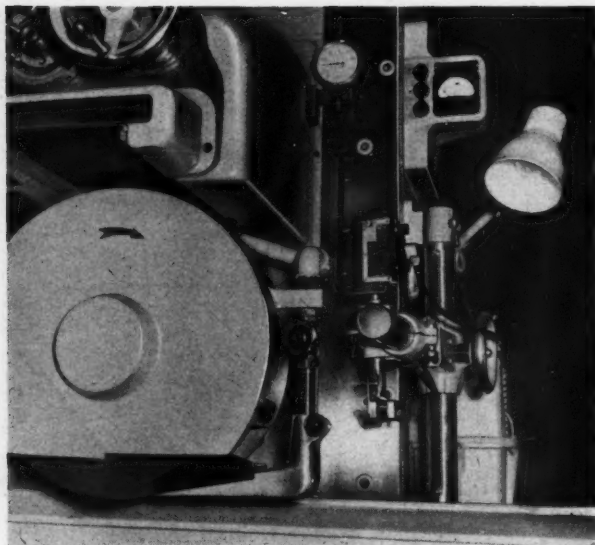


Fig. 5. The automatic cycle of the type 3722 surface grinder is controlled by means of this gauging unit, which is mounted on the side of the column, and can be adjusted both vertically and horizontally

vertical spindle machine shown at the recent Leipzig Fair (MACHINERY, 98/1198—24/5/61). Workpieces with plan dimensions up to 12.6 by 39.4 in., and heights up to 15.75 in., can be accommodated. The grinding wheel is mounted on the spindle of the 13.4-h.p. driving motor, which is carried in horizontal ways in the vertical slide casting, movements in both the horizontal and vertical directions being automatically controlled.

There is a choice of 10 vertical feed increments for the wheel-head, ranging from 0.0002 to 0.002 in., also rapid traverse in the vertical direction at 16 in. per min. Feed increments may be applied manually or automatically, under the control of a measuring unit mounted on the right-hand side of the column, as seen in

Fig. 5. This unit can be adjusted vertically and horizontally to suit the position of the control surface on the component. During an automatic cycle, the wheel-head is lowered at the rapid traverse speed to a pre-set height, and roughing feed increments are then applied at each reversal of the cross-traverse motion.

During this roughing stage, the height of the work is measured by the instrument, and when it reaches a pre-set value the feed is changed to 0.0002 in. increments for finishing. The table is reciprocated hydraulically, at speeds which can be steplessly varied between 6.5 and 131 ft. per min. Steel strips are fitted to protect the table ways from abrasive, and the column ways are enclosed by telescopic covers. Coolant is delivered to the wheel housing by a separate pump unit, and is

Fig. 6. Built by the Moscow jig boring machine factory, the type 5822 universal thread grinder can be employed for operations on gauges, screws and worms, flat and circular thread chasers, racks, and form tools, also for form relief grinding taps, hobs, and thread-milling cutters

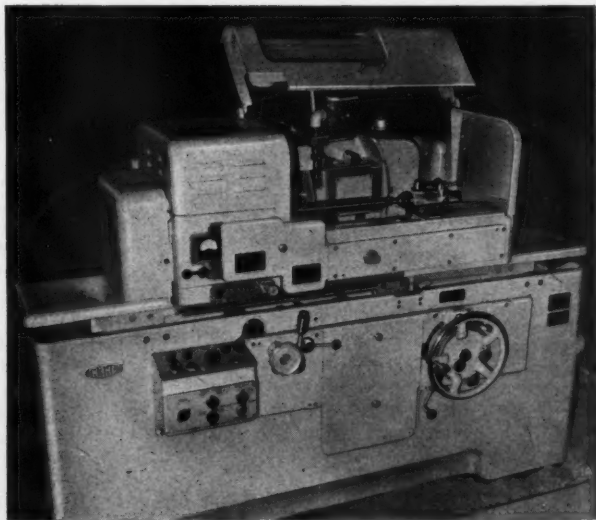
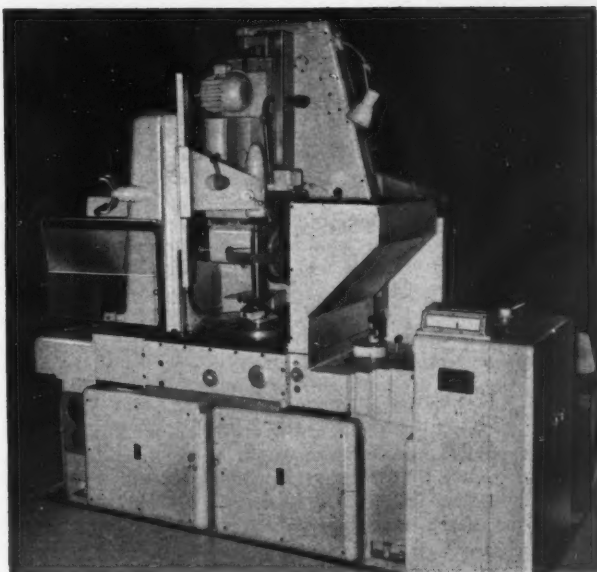


Fig. 7. Designed and built by the ENIMS research institute, this type 584M machine provides for grinding straight and helical spur teeth on gears from 2.362 to 19.68 in diameter, by a generating method



passed through a magnetic separator and filter unit before being recirculated.

UNIVERSAL THREAD-GRINDING MACHINE

The type 5822, universal thread grinder seen in Fig. 6, which is built by the Moscow jig-boring machine factory, has a capacity for external threads up to 7.87 in. diameter and admits a maximum length of 19.68 in. between centres. A variety of work can be ground on this machine, including thread gauges, screws and worms, flat and circular thread chasers, racks, and form tools, and it may also be used for form-relieving taps, hobs and thread-milling cutters. Either single- or multi-ribbed wheels, of a maximum diameter of 15.75 in., and a face width of 0.39, 0.78 or 1.57 in. can be employed. The spindle is driven by a 6-h.p. motor, and there is a choice of six speeds from 1,430 to 2,860 r.p.m.

There is an automatic diamond dressing device for producing the required form on the wheel, and automatic compensation for the material removed is made by advance of the head. When multi-rib wheels are employed for grinding short workpieces, the wheel-head can be plunge-fed on an automatic cycle.

The work-spindle is driven by a 0.6 h.p., d.c. motor, supplied from a motor-generator set, which provides steplessly-variable speeds from 0.3 to 45 r.p.m. During the rapid return motion of the table, the work-spindle is driven at 100 r.p.m. Change gears determine the pitch of the thread ground, and there is a special mechanism on the table which provides for fine adjustment of pitch by means of a micrometer screw. This mechanism enables the pitch obtained from the change gears to be varied within ± 25 per cent of the nominal value, when threads of extra high accuracy, of great length, or of non-standard pitch are to be produced.

External English threads from 3 to 28 or 5 to 28 per in., and metric pitches of 0.25 to 60 and 0.75

to 4 mm., may be ground with single- and multi-ribbed wheels respectively. The maximum depth is 0.708 in., and multi-start threads with a maximum of 48 starts can be ground, the limiting helix angle being 15 deg. in either direction. For relief grinding, the amount of relief can be varied from 0.0008 to 0.1575 in., and the number of lands may range from 2 to 18.

Internal threads can also be ground, by means of an attachment which is mounted on machined and scraped surfaces at the front of the wheel-head, in bore diameters from 0.98 to 4.9 in., and with lengths up to 2.95 and 2.16 in. for single- and multi-ribbed wheels. Pitches of internal threads may range from 0.019 to 0.236 in. for single- and from 0.039 to 0.118 in. for multi-ribbed wheels, and the helix angle is limited to 8 deg. in either direction. External and internal tapered threads can also be ground on the machine.

For trapezoidal form threads pitches may range from 0.078 to 0.2362 in. and from 0.078 to 1.57 in. with single- and multi-ribbed wheels. A special fixture is available for grinding large helix angle worms without distortion of the profile, and square threads may be ground with the internal attachment. Coolant supply equipment, including a motor-driven pump and filter, is built into the machine. The overall dimensions are 7 ft. 9 in. by 6 ft. 7 in. by 4 ft. 10 in. high, and the machine weighs about 3.9 tons.

Built by the ENIMS research institute, the type 584M, semi-automatic gear grinding machine,

shown in Fig. 7, is intended for grinding straight and helical tooth gears by the generating process, using a single-ribbed wheel which operates on adjacent flanks of two teeth simultaneously. During the grinding operation, the wheel is reciprocated vertically and plunge fed to a stop while the gear is rolled slowly past it, in mesh with the profile. After a tooth space has been ground, the wheel-head moves back and the work is returned to its original position, while continuing to rotate in the same direction as during grinding.

With this arrangement the work is indexed through a number of tooth spaces which is not a factor of the number of teeth in the gear, and differential indexing is avoided.

Gears of 2.362 to 19.68 in. diameter, with face widths up to 7 in., and of 2 to 10 mm. module (12.7 to 2.54 d.p.), with numbers of teeth from 8 to 150, can be ground on the machine. The wheel is driven from a 0.75-h.p. motor mounted on the slide, through a flat belt, at a speed of 2,200 r.p.m., and the column can be set over to any angle up to 45 deg. by means of a mechanism at the rear, as seen in Fig. 8, in conjunction with a scale and vernier. The number of strokes of the slide carrying the wheel spindle can be varied from

34 to 268 per min., and the number of tooth spaces through which the work is to be indexed is set on a small dial at the lower right-hand side in Fig. 8.

Wheel dressing is performed by means of a unit with three diamonds, which is operated automatically, either after a number of passes, or when a push-button is pressed. The diamonds can be set so that two or three are brought into operation at the same time, and compensation for the material removed is made automatically. The machine operates on an automatic cycle and stops when all the teeth of the gear have been ground. It measures 8 ft. 4 in. by 7 ft. 6 in. by 7 ft. 7 in. high, and weighs approximately 6 tons.

Importation of Russian-built machine tools into this country is being handled by United Machinery Services, Ltd., 4-7 Burford Road, London, E.15, and Machine Tool Agencies, Ltd., 79 Portland Place, London, W.1.

THE NEED FOR CONSISTENT TESTS FOR NOISY MACHINES. Because human judgment of excessive machine noise is unreliable, D.S.I.R. scientists at the National Engineering Laboratory are prepared to develop instruments to ensure consistent standards of inspection.

The need for such instruments was emphasized by recent experience in an electric motor factory, where inspectors were rejecting 25 per cent of the motors in a batch, and it was discovered that they agreed about fewer than 10 per cent of the rejects.

In previous attempts to standardize tests for noise, sound meters have sometimes been used, but where such a meter registers the total volume of noise, regardless of its source, it is of little help for the purpose. Experience has shown that certain parts of a machine are usually responsible for noise in a particular frequency range. For example, noise in the bearings of an electrical machine occurs in the frequency range 1,000-1,200 c/s, and electrical noise in the range 100-160 c/s. In the N.E.L. instruments, the usual microphone and amplifier will be combined with suitable filtering circuits, to measure noise levels in different frequency bands. Thus, it should be possible to identify the source of noise in the type of machine for which the instrument was designed.

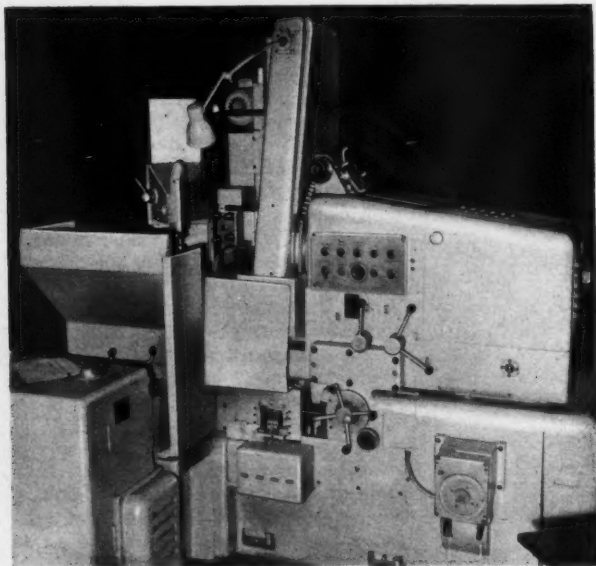


Fig. 8. In this view from one side of the type 584M machine may be seen the angular adjustment mechanism for the column, which can be set at angles up to 45 deg. on each side of the vertical

British Welding Research Association

A new Engineering Laboratory was formally opened recently at the Abington Hall premises of the British Welding Research Association by the Rt. Hon. Lord Mills, P.C., K.B.E. The ceremony was performed during one of the open days, which afforded visitors an opportunity of seeing something of the work that is being carried out by the Association in connection with various aspects of welding.

Of 2-storey design, the new laboratory is intended to replace a number of recently-vacated buildings at the Abington Hall site, and various offices are provided on the first floor, which has an area of 8,000 sq. ft. There are no dividing walls on the ground floor of the building, which covers an area of 15,000 sq. ft., and houses a machine shop, a welding shop, and equipment for carrying out investigations in connection with resistance welding, brittle fracture, and pressure vessels. Machines with ratings of 700 and 2,000 tons, which have been in use in other laboratories at Abington Hall for some time, for carrying out tensile tests on steel plates up to 3 in. thick, have been transferred to the new building. Another machine which has a rating of 4,000 tons is being developed for carrying out tensile tests on mild steel plates up to 36 in. wide by 6 in. thick, and alloy steel plates up to 4 in. thick.

Work is in progress in the new laboratory on measurement of the temperature cycle during spot welding, with the object of determining the amount of post-weld heat treatment that is necessary to prevent brittleness in the work. For this investigation, alumina thermo-couples in the form of very small wires are employed, which are mounted vertically in the electrodes on the spot welder, or between the plates to be welded, and temperature variations are indi-

cated on a high-speed ultra violet galvanometer or an oscilloscope. It is reported that in some instances the thermo-couples have melted within the weld "nuggets" which indicates that the peak temperatures reached in the work are at least 2,000 deg. C.

With conventional seam welding, the current is switched on and off at very short, regular, intervals, to produce a series of overlapping welds. Although satisfactory welds are obtained by this procedure in many steels, cracking sometimes results when it is employed for high alloy stainless steels. Investigations so far carried out have shown that cracking is eliminated when a continuous a.c. supply is employed for welding such steels, and it appears that the conditions for welding are then less critical than those for welding with an interrupted current. It is stated that work in this field will be continued.

FRICTION WELDING MACHINE

Although patents in connection with friction welding were granted in this country as early as 1941 and 1942, much development in this field appears to have taken place in Russia and Czecho-

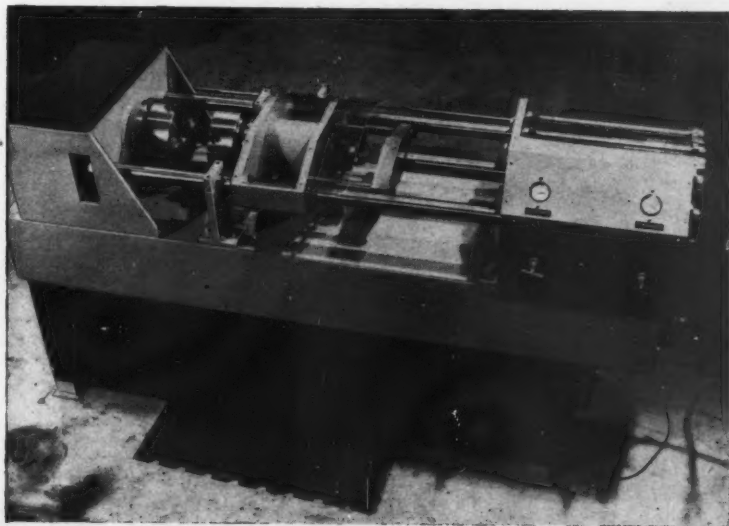


Fig. 1. This friction welding machine has recently been built by the British Welding Research Association

slovakia during recent years, and some work which has been undertaken in the latter country was discussed in *MACHINERY*, 97/892—19/10/60. The machine shown in Fig. 1 has recently been built by the British Welding Research Association, for carrying out investigations on friction welding, and was available for demonstration during the open days.

As was explained in the earlier article, friction welding is a form of pressure welding in which two workpieces to be joined are held in contact and rotated relative to each other. Due to the rotation, the joint faces become heated, so that the metal is brought to a plastic condition, whereupon the contact pressure is increased to complete the weld.

It is stated that the friction welding process has some of the advantages of the more commonly-known resistance welding processes, and requires less power.

The B.W.R.A. machine has a capacity for friction welding mild steel bars of cross-sectional areas up to 1 sq. in., and has two 4-jaw chucks for holding the pieces to be joined. Drive to the spindle which carries the left-hand chuck is taken from a 10-h.p. motor, through a timing belt, and spindle speeds of 430, 640, 800 and 1,200 r.p.m. can be obtained by means of interchangeable stepped pulleys. When the driving motor has been started at the beginning of the working cycle, the spindle housing for the right-hand chuck is advanced on cylindrical guide bars, by a 12-in.

diameter double-acting air cylinder, to bring the ends of the component pieces into contact with each other for welding. During the pre-heating stage of the welding cycle, the spindle for the right-hand chuck is prevented from rotating by an arm secured to its right-hand end, which makes contact with a stop. At this stage, due to the heating of the workpiece metal, some upsetting takes place, and the spindle housing continues to advance on the guide bars under air pressure which is maintained at both sides of the piston. When the metal has been brought to the plastic condition, and has been upset by a pre-determined amount, a pusher bar at the rear of the bed, which is connected to—and travels with—the spindle housing, operates a micro-switch. As a result, air pressure at the piston rod end of the cylinder is released and the upsetting force on the component parts is increased. At the same time, the stop is brought clear of the end of the arm by means of a solenoid, so that the right-hand spindle and the welded workpiece can rotate with the left-hand spindle. In addition, operation of the micro-switch causes a brake to be applied to stop the driving motor.

The right-hand spindle runs in a taper roller bearing at the nose end and a cylindrical roller bearing at the rear end, and it is stated that no twisting takes place in mild steel bars down to $\frac{1}{8}$ in. diameter when the stop is moved clear at the end of the welding operation. When compressed air at 100 lb. per sq. in. is delivered to the cylinder, a maximum upsetting force of 5 tons can be applied to the component parts being welded.

At the bottom in Fig. 2 may be seen two $\frac{1}{8}$ -in. diameter mild steel bars which have been joined by friction welding. Other $\frac{1}{8}$ -in. diameter friction welded mild steel bars on which tensile and bending tests have been carried out are shown in the centre and at the top.



Fig. 2. The bottom view shows two $\frac{1}{8}$ -in. diameter mild steel bars which have been joined by friction welding. Other $\frac{1}{8}$ -in. diameter friction welded mild steel bars on which tensile and bending tests have been carried out are seen in the centre and at the top

Books Received

WOMEN ENGINEERS IN THE U.S.S.R. Report by L. S. Souter, B.Sc., A.R.T.C., A.M.I.E.E., M.W.E.S., and R. Winslade, M.S.I.T., M.W.E.S. The Caroline Haslett Memorial Trust, 25 Foubert's Place, London, W.1. 28 pp.

This informative report which was recently presented gives the results of a study tour by the authors under a travelling exhibition awarded by the General Section of the trust. It includes sections under such headings as: education system of the U.S.S.R.; history of the entry of women into engineering; distribution of women in various types of engineering; lower technical qualifications; do women make good engineers?; mental attributes; physical attributes; economic factors; social factors; marriage and domestic responsibilities; and acceptance.

NEWS OF THE INDUSTRY

The Midlands

E.M.B. Co., LTD., Moor Street, West Bromwich, Staffordshire, report that the output of die casting machines from their works last year was the greatest they have yet achieved. The No. 16 die casting machine, which is shortly to be demonstrated, is intended for cold or hot chamber working, and has a locking force of 225 tons. It is designed for high-speed operation under automatic control and may be employed for single cycle or continuous working.

E.M.B. electrical equipment continues to be in strong demand from the home and overseas markets and we may note that the company has recently provided controllers for grabbing cranes destined for Russia. An order has also been received for E.M.B. controls incorporating Microsen speed variation equipment for 14 overhead travelling cranes required for installation in a vehicle factory.

The facilities in the works have been improved by the provision of a water-wash paint spraying booth, and the addition of a department for the production of sheet metal assemblies. Gradual replacement of machine tools and workshop equipment during the past seven years has resulted in a general improvement in production efficiency.

TAY TOOL WORKS, LTD., Spon Lane, West Bromwich, are busy with the production of Fellows type gear shaper cutters and Cornelis type thread generating cutters. Orders for such cutters are being received by the company on an increasing scale, and we are informed that deliveries to export markets are tending to rise.

MIDLAND MACHINE TOOL CO. (BIRMINGHAM), LTD., Spon Lane, West Bromwich, are well placed for machine tool rebuilding work and in this connection we may note that facilities are provided for restoring centreless grinding machines, thread rolling machines, and universal grinding machines, for example, to the original limits of accuracy. Contract machining of close tolerance parts is also undertaken, and we understand that there has been a steady expansion of this side of the business. Additional machine tools have been installed including a Colchester Mascot 8½-in.

centre lathe and a Binns & Berry JB lathe. A Jones & Shipman universal grinding machine is on order.

DENBIGH ENGINEERING CO., LTD., Horseley Heath, Tipton, Staffordshire, are experiencing a steady call from merchants for their bench and pedestal drilling machines and D type horizontal milling machines. The latter, which supersedes the well-known C type, has a steplessly-variable drive to the spindle and powered table traversing movement. It may be arranged for air/hydraulic table operation, for production work, if required.

RUSSELL AUTO-FEED SCREWDRIVERS (Branch of Needle Industries, Ltd.), Studley, Redditch, Worcs., are extremely busy in meeting the demand



Special-purpose Russell Auto-Feed screwdriving machine for inserting six screws simultaneously into terminal blocks

for their range of screw- and pin-driving machines which are widely employed in this country and other parts of the world for inserting wood screws and metal screws, including grub screws, also a variety of headed pins, in terminal blocks, spectacle frames, and clock assemblies, for example. Standard machines are built for inserting one, two, or three screws or pins automatically, in one operation, and other machines, with hopper feeds and special purpose fixtures, can be supplied for special applications.

One of the latter, built for inserting six screws simultaneously in terminal blocks, is shown in the illustration on page 225. Screws, tipped into the hopper at the top of the machine, are directed, by the movement of a hinged plate, into grooves communicating with six vertical tubes, and thence to the multiple screwdriving head mounted above the work. The machine is controlled by a pedal, and provides for inserting screws at rates in excess of 200 per min.

Mention may also be made of special machines for the automatic insertion of screws, in pairs, into electric plugs; and of a more complicated machine, with hopper feeds and four work stations, for the assembly of clock components. On the latest standard machine which has added to the range, the spindle speed has been increased to 1,000 r.p.m. as compared with the previous speed of 600 r.p.m.

PNEULEC, LTD., Mafeking Road, Smethwick, Birmingham, 40—founded in 1921—specialize in design and construction of a wide variety of foundry equipment intended mainly for the production of ferrous castings in the medium and large size ranges. The scope of this company's activities covers a large field, including the provision of plant for the drying and conveying of sand, also equipment for the moulding and casting of metals and the production of cores by various methods. The research department is at present occupied with several interesting projects, one of which is concerned with the reclamation of core sand, and another with the development of hydraulically-operated squeeze-moulding equipment which will incorporate a self-contouring head designed to afford close control over the horizontal and vertical flow movements of the moulding sand.

F. W. HERRIDGE.

Halifax and District

HALIFAX TOOL CO., LTD., West Lane, Southowram, report that their works are maintaining a high rate of production of Halco-Stennick deep-hole rock drilling machines. Other activities of

the company include the production of a wide range of tungsten-carbide components, from the raw materials stage. These products include a range of Halco standard lathe tools; cutters and tools for rock and coal boring; tools for the pottery trades; sand blasting nozzles; and components for use in the chemical and textile industries. We are informed that approximately 70 per cent of the total output of the works is exported to various countries.

A new heat treatment department, with an area of some 4,000 sq. ft., has recently been built and additions to the machine shop plant have included a Dean, Smith & Grace type 21 centre lathe and a Union horizontal boring machine.

DENHAM'S ENGINEERING CO., LTD., Holmfild, inform us that the works are at present concentrating on the production of the standard range of 17- to 42-in. swing centre lathes, and that the 17-, 22- and 25-in. swing machines have been in particularly good request in recent months. A steady flow of export orders for these lathes is being received, South Africa and New Zealand being prominent among overseas markets.

The type B.V. lathe, shown last year at Olympia, has been well received, and the range of sizes has recently been extended to include 29-, 32- and 37-in. swing capacities. All lathes of this type will be available shortly with hardened and ground steel bed-ways as an optional feature.

Machines recently despatched from the works have included three 25-in. swing lathes with hardened and ground steel bed-ways for David Brown Industries, Ltd., Heavy Gear Division; two similar machines, provided with profiling equipment, for the Chesterfield Tube Co., Ltd.; and two 28-in. swing lathes designed for turning Nimonic billets, one of which is arranged for facing operations at constant cutting speed; also a number of lathes for India.

BINNS & BERRY BROTHERS (HALIFAX), LTD., Ovenden, report an unparalleled demand for their standard 12½-in. centre lathe. Approximately 50 per cent of the orders now in hand are for export to various countries including Japan, Sweden, and the U.S.A. Work at present in progress includes a number of lathes with 25-ft. long beds which are destined for Japan.

We are informed that the thread whirling machines built by the company are being progressively developed, and that there is a steady call for these machines, mainly from the home market.

HALIFAX RACK & SCREWCUTTING CO., LTD., Ovenden, suppliers of precision cut machine racks

and traverse screws, report a heavy increase in the demand for their services, especially from the machine tool industry.

We are informed that output over the past twelve months has been increased by 100 per cent, and that a new rack cutting machine and a new thread whirling machine are shortly to be installed to help to keep pace with increasing production requirements.

WILLSON LATHES, LTD., Ovenden, report that their works are busy with the production of the Mk.5. centre lathe, which is available with bed lengths up to 18 ft., machines with beds up to 12 ft. long having hardened and ground ways; also the 6-in. Mk.1. centre lathe which has hardened and ground bed-ways and is built in two sizes of 2-ft. and 3-ft. length capacity between centres. In addition, a number of the 11-in. centre height lathes, with vee-guide beds, are being built with bed lengths ranging up to 20 ft., to meet a steady demand.

To permit more efficient production, a reorganization and re-equipment programme is at present being carried out in the works, and machine tools recently installed have included a Warner & Swasey type 2.A.C. automatic; a Samand tool grinder; and a 13-in. centre lathe with a 25-h.p. motor drive, of the company's own make. A Town radial drilling machine and a Lumsden surface grinder are due for early delivery.

R. SUTCLIFFE.

Bradford

MOORE MANUFACTURING CO., LTD., Blanche Street, report that during recent months there has been a continued increase in the demand for their range of engineers' small tools which includes lathe centres, milling cutters, drill sleeves and sockets, milling machine arbors and adapters, end mills, and reamers. We are informed that a good proportion of the current production is for export, and that, in particular, a large volume of orders for drill sleeves and sockets is being received from many countries overseas. Among machine tools and equipment recently installed in the works may be mentioned a Scrivener centreless grinder and two Parkson No. 2 universal milling machines.

CROFTS (ENGINEERS), LTD., Thornbury, are busy with their wide range of products, and demand for radiation gear units, couplings, V-belt drive units, and Ritespeed motorized conveyor pulley units is particularly heavy at present. The contract gear cutting department of the works and the ferrous and non-ferrous foundries are reported to be working to capacity.

A new stock holding branch was recently opened by the company at 21 Smith Street, Manchester, 16, to provide an improved service for the engineering industry in the North-West.

T. BOWERS & CO., LTD., Thornbury Street, inform us that their factory is at present working to full capacity on the range of small tools, also on jigs, fixtures, gauges, and special tooling, which are made on a contract basis. The company's new internal micrometer has been well received in both the home and export markets, and a number of the orders in hand for this instrument are from Sweden, France and Norway. New plant recently installed in the works includes a Jones-Shipman universal grinding machine and three toolroom lathes.

STANHOPE ENGINEERS, LTD., 92 Harris Street, report that they have a large volume of orders from both home and overseas customers for their range of rotary gear pumps, including an important contract from Italy covering units of various sizes. Fuel oil transfer pumps are in steady demand, and it was noted that a large amount of contract machining work is at present being undertaken.

HINDLE AUTO PRODUCTS, LTD., Caledonia Street, inform us that they are experiencing an unparalleled demand for precision gears, spline shafts, and gearbox units. Work at present in progress includes a number of ground splined shafts for use in the nuclear energy field and we are informed that the tolerances specified for these shafts are only 25 per cent of the British Standard values. Mention may also be made of a 5½-in. diameter component with 21 involute splines for which a single cutter and an indexing fixture are employed. This part must be produced with a pitch accuracy of 0.001 in.

Equipment recently installed in the works includes a Milnes heavy-duty fine boring machine with Hilger & Watts optical measuring equipment; a Churchill Redman P.5 automatic copying lathe; and a Birfield-Somua hydraulic spline milling machine.

STERLING MANUFACTURING CO., LTD., Lower Cobden Street, inform us that although the works are making independent and self-centring lathe chucks on a limited scale, the greater part of the production capacity is devoted to the machining of a wide range of components on a contract basis, for companies engaged in various branches of engineering. It was noted that whereas most sections of the works are fully occupied, a small amount of milling capacity is at present available.

ELLIOTT & MUSGRAVE, LTD., Longside Lane, makers of patterns in wood, metal and plastics, in-

form us that they are experiencing an increasing call for their services from the machine tool, motor car, and other engineering industries. The company also supplies textile conveyors to a number of machinery builders, and we are informed that this section has been very busy during recent months.

HENRY MILNES, LTD., Ingleby Works, Rosse Street, report a steady call for their standard milling machines and centre lathes and a growing demand for their range of heavy-duty fine boring machines. We are informed that orders have been received for a number of double-ended machines in the past few weeks and that the standard types are now available with Micro-bore tooling, Hilger & Watts optical measuring equipment, and Ferranti co-ordinate positioning equipment.

It was noted that the company has recently developed a push-button operated automatic draw bar for incorporation in the spindles of fine boring machines, which is at present undergoing tests in a customer's works. We hope to publish full details of this equipment in a future issue.

N. JOWETT & Co., LTD., Littlemoor Works, Queensbury, report that they are busy with the production of their thread milling and gear hobbing machines. A number of these machines was recently exported to Australia, and numerous enquiries have been received from India and the South American countries. Recent additions to the machine tools installed in the works include a Churchill cylindrical grinder.

R. SUTCLIFFE.

Personal

MR. R. A. NICHOLSON, steel sales manager of Sanderson Brothers & Newbould, Ltd., Attercliffe Steelworks, P.O. Box No. 6, Newhall Road, Sheffield, 9, recently retired after 51 years of unbroken service with the company. He was formerly production manager of the steel department.

MR. D. F. CAMPBELL, chairman of Davy-Ashmore, Ltd., Darnall Works, Sheffield, 9, has announced his intention to retire from the board at the conclusion of the forthcoming annual general meeting in September. The directors of the company have designated Mr. M. A. Finnes to succeed him, and Mr. L. H. Downs will become vice-chairman.

MR. D. J. AMERY and **MR. J. E. CONNOR**, who are production engineers at the Telephone Works of The General Electric Co., Ltd., in Coventry, have been awarded Sir Alfred Herbert Travelling Scholarships for 1961. These awards are made annually by the Machine Tool Trades Association in commemoration of the 90th birthday of the late Sir Alfred Herbert.

MR. STAFFORD BEER, who has been head of the department of operational research and cybernetics of The

United Steel Companies, Ltd., The Mount, Broomhill, Sheffield, 10, since its inception in 1957, has resigned to become managing director of a new international firm of operational research consultants based in London. **MR. DAVID OWEN**, previously assistant head of the department, will succeed Mr. Beer from August 1.

The following new appointments have been announced:—

SIR BEN LOCKSPEISER, **MR. C. F. HODSON**, and **MR. W. H. WEST** as directors of **J. H. Shand, Ltd.**, Anchor Hill, Axminster, a member company of the Staveley Group.

MR. JOHN T. MCCARLEY, director of manufacturing-international, as managing director of the British Division of **The Yale & Towne Manufacturing Co.**, Willenhall, Staffs.

MR. ROBERT W. SUGDEN as sales representative for **Landis Lund, Ltd.**, Cross Hills, Keighley, in Yorkshire and the North Midlands. He was formerly sales representative for the company in Ireland and the North Eastern counties.

MR. JOHN A. KNOWLES as a member of the sales staff at the Bristol office of **Brook Motors, Ltd.**, Huddersfield. A former Brook apprentice, he has been with the company for 12 years.

MR. B. D. BLACKWELL, deputy chief engineer, Aero Research and Development, to succeed Brigadier **J. Innes** (a special director) as business manager, Aero, for **Bristol Siddeley Engines, Ltd.**, Patchway Works, P.O. Box 3, Filton, Bristol.

MR. J. D. WRIGHT as manager of the Templeborough melting shop of the Steel, Peech & Tozer branch of **The United Steel Companies, Ltd.**, The Mount, Broomhill, Sheffield, 10, in succession to **MR. H. H. England**, who has resigned.

MR. PERCY ALLAWAY as managing director of **E.M.I. Electronics, Ltd.**, Hayes, Middlesex, in succession to **MR. Clifford Metcalfe, C.B.E.**, who has relinquished the post at his own request. **MR. Metcalfe** remains a full-time director of **Electrical & Musical Industries, Ltd.**

MR. M. H. GARDINER, F.C.A., and **MR. C. PHILLIPS, M.I.Mech.E., M.I.Prod.E.**, as joint managing directors of **Redman Tools & Products, Ltd.**, Gregory's Bank, Worcester. **MR. A. M. REDMAN** continues to hold the office of chairman.

MR. E. MASON, as general manager of the factory of **Rank Precision Industries, Ltd.**, Cine and Photographic Division, Mitcheldean, Gloucestershire, makers of Bell & Howell 8-mm. and 16-mm. cinematographic equipment and allied products. He was previously works manager of **Brush Electrical Engineering Co., Ltd.**, Loughborough.

MR. CHAS E. ROGERSON, O.B.E., F.C.A., as vice-chairman, and **MR. V. M. MARSHALL, M.I.Loco.E.**, as a director of **Edward G. Herbert, Ltd.**, Atlas Works, Levenshulme, Manchester, 19. **MR. ALAN KIERNAN, M.I.Mech.E.**, and **MR. SAM SMILEY, F.C.C.S., A.A.C.C.A.**, who were directors, have retired from the service of the company.

MR. TIMOTHY H. KINDERSLEY, M.A., A.M.I.C.E., as chief engineer of the Engineering Products Division of

Allis-Chalmers Great Britain, Ltd. He will be at the London office in Salisbury House, London Wall, E.C.2. The position has been newly created in connection with the company's programme of expansion.

Progress of New Ferodo Factory

On July 17, Mr. Ronald Soothill, chairman of Turner & Newall, Ltd., laid the foundation stone of the new factory which is being built for Ferodo, Ltd., Chapel-en-le-Frith, Stockport (a member company of the Turner & Newall Group), at Griffiths Crossing, Caernarvon, at a cost of £2½ million. Excavation work began in January, and the steel framed building is already almost fully cladded. It is estimated that the project will be completed by April, 1962. The factory, which is being built by Taylor Woodrow Construction, Ltd., will produce textile brake linings and clutch facings and Ferodo non-slip stair-treads. The main production block will have an area of 240,000 sq. ft.

Work will be provided initially for 500 people, and the number may later rise to 1,000.

U.S. Machine Tool Exports

The following table gives the quantities and value of exports of various classes of machine tools from U.S.A. during February, 1961:—

	Number	Value \$
Light-duty and bench lathes	41	49,907
Engine lathes	65	360,985
Turret lathes	19	343,777
Automatic chucking and between-centre lathes	30	1,473,928
Automatic screw machines	13	601,739
Other lathes	16	325,990
Vertical boring and turning mills, and vertical turret lathes	5	63,176
Fine boring machines	2	22,560
Jig boring machines	6	358,653
Tapping and threading machines ..	153	195,377
Milling machines	73	470,315
Profiling, duplicating and diesinking machines (milling type)	17	269,535
Gear cutting machines	80	1,823,537
Gear grinding and finishing machines ..	33	458,246
Drilling machines	187	620,767
Planing, shaping and slotting machines	15	264,317
Surface grinding machines	66	716,557
Tool and cutter grinding machines ..	63	354,956
Other grinding machines	413	2,974,052
Sawing and cutting-off machines ..	69	188,460
Honing and lapping machines	33	251,779
Multi-station machine tools	2	471,403
Broaching machines	1	64,907
Hydraulic presses	59	634,179
Mechanical presses	106	1,278,228
Bending and roll forming machines ..	102	604,582
Punching and shearing machines ..	51	292,798
Forging machines and hammers ..	43	676,296
Other machines	185	597,318

MACHINERY'S ENQUIRY BUREAU

For many years MACHINERY has provided an enquiry service not only for subscribers and advertisers but for all engineers in need of such information as the names of makers—or their agents—of machines or equipment for performing particular operations, suppliers of various classes of material, firms with facilities for undertaking certain types of work, owners of trade names, and agents for foreign machine builders. If you have such a problem write (MACHINERY, Enquiry Bureau, Clifton House, 83-117 Euston Road, London, N.W.1) or telephone (Euston 8441, 2 lines). This service is, of course, entirely free.

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Industrial Notes

INSTRUMENTS & MOVEMENTS, LTD.—From August 8, the address of this company will be Half Moon Hill, London Road, Dunstable, Beds. The telephone number (Dunstable 64414-5) will not be changed.

CRANES (DEREHAM), LTD., Dereham, and **CRANE FRUEHAUF TRAILERS, LTD.**, North Walsham, inform us that the address of their London office is now 8 York Buildings, Adelphi, W.C.2 (telephone, Trafalgar 1781).

TESTING MACHINES INC., 72 Jericho Turnpike, Mincola, Long Island, N.Y., U.S.A., have issued a list covering 1,239 physical testing machines, compiled from world wide sources. The various items are arranged alphabetically. Copies of the list are obtainable from the above address.

ADREMA, LTD., Telford Way, East Acton, London, W.3, recently announced that staff conditions would in future apply to all the hourly-paid workers in their six factories. Clocking-in has thus been abolished, and all workers will have three weeks' holiday with pay, and will participate in the staff pension scheme. Instead of clocking-in, employees will sign in a book.

BRITISH INDUSTRIAL ENGINEERING CO., LTD., Tividale, Staffs., report continued expansion of business, especially in overseas markets. During the first six months of this year, the value of exports of pipe supports and structural steelwork increased by 50 per cent. To meet the expanding demands, additional factories have been opened at Old Hill, Staffs., and Droitwich, Worcs.

ASSOCIATED ELECTRICAL INDUSTRIES, LTD., Crown House, Aldwych, London, W.C.2, have entered into an agreement with Facit Electronics AB of Sweden, whereby the Electronic Apparatus Division have been appointed sole agents in the United Kingdom and British Commonwealth (except Canada) for the Facit Carousel random access magnetic tape memory machine, high-speed tape punch, and high-speed reader.

THE INDUSTRIAL WELFARE SOCIETY, Robert Hyde, House, 48 Bryanston Square, London, W.1, have issued a booklet by Dr. Patricia Shaw entitled "Enjoying Retirement." It is intended to benefit those who will be retiring on pension in four or five years' time, and to help them "to prepare now to transform those potentially empty years into years of useful leisure." Copies are obtainable from the above address, price 2s. 6d. each, plus 6d. postage.

PYE-LING, LTD., is the title of a new company which has been formed by Pye, Ltd., Cambridge, and Ling Temco Electronics, Inc., Dallas, Texas, U.S.A. This company replaces the Vibration Division of the Pye subsidiary W. Bryan Savage, Ltd., and the products will include the Savage range of vibration testing equipment and the Ling range. It is pointed out that these ranges are largely complementary.

HANCOCK & CO. (ENGINEERS), LTD., Croydon, Surrey, recently despatched a special oxygen cutting machine for plate splitting to the South African Iron and Steel Industrial Corporation, near Johannesburg. This machine the cost

of which exceeds £5,000, has a capacity for plates from $\frac{3}{4}$ to 9 in. thick, and the cutting area is 80 ft. by 12 ft. It is of the gantry type and is fitted with 12 individual floating vertical burners. To meet customers' requirements, provision has been made for cutting 45-deg. bevels.

GENERAL TRADE EQUIPMENT, LTD., 82-90 Seymour Place, London, W.1, are now marketing an eye magnet probe with magnifier. Of stainless steel, the instrument has a fluted barrel along which a magnifying glass can be adjusted. There is a cap at each end of the barrel, one containing a magnet for the removal of iron and steel particles, and the other a looped piece of cat-gut for non-magnetic matter. The magnifying glass is focussed on the object in the eye.

THE UNITED STEEL COMPANIES, LTD., The Mount, Broomhill, Sheffield, 10, have purchased Barrow Steel Works, Ltd., from the Iron and Steel Holding and Realisation Agency for the sum of £2,200,000. United Steel have managed the works since 1943, and in 1952 a pilot continuous casting plant was installed for the purpose of producing billets for re-rolling from local scrap supplies. The process, it is stated, is now being operated successfully, and two full-scale, twin-strand, continuous casting machines and a 20-ton electric arc furnace are being installed.

FIELDING & PLATT, LTD., Gloucester, have received an order from Henry Wiggin & Co., Ltd., Hereford, for a 3,500-ton Fielding horizontal hydraulic press for the extrusion of Nimonic alloys. The total value of the contract, which also covers auxiliaries, is of the order of £250,000. Provision will be made for the use of a piercing mandrel to enable both solid and hollow sections to be produced, and a number of novel features will be included to permit close control of the extrusion process and to enable idle time to be reduced. The press will be direct pumped, and the total installed brake horse power will be approximately 4,000.

TRANSPORT COSTS FOR INDUSTRY IN NORTHERN IRELAND. The results of an inquiry into transport costs as a factor affecting the development of industry in Northern Ireland were recently announced by the Northern Ireland Development Council. The inquiry covered 15 different types of industry and showed that, with one exception, the transport of finished products from Northern Ireland did not exceed 2.8 per cent of the sales value, and in ten industries was less than 1.5 per cent. Costs of inward transport of raw materials did not exceed 2 per cent of subsequent sales value, and in nine industries were less than 1 per cent. For light engineering, inward transport costs of raw materials were 1.9 per cent, and outward costs 0.6 per cent of sales value.

WILD-BARFIELD ELECTRIC FURNACES, LTD., Elecfurn Works, Otterspool Way, Watford By-Pass, Watford, Herts., inform us that they have recently received exports orders from ten different countries, and that overseas business now accounts for some 30 per cent of their sales. These orders

embrace, for example, vacuum induction and resistance heated furnaces for Sweden and the International Atomic Energy Agency in Austria; a vertical pit type gas carburising furnace for Sweden; a large mesh belt conveyor type and an ACE sealed quench furnace for Holland; a pit type vacuum furnace of the internal element type and an electron beam welding unit for Belgium; and a mains frequency induction-heated aluminium holding furnace for Japan.

NAPIER AERO ENGINES, LTD. The English Electric Co., Ltd., and Rolls-Royce, Ltd., have agreed in principle on arrangements whereby the aero engine business of D. Napier & Son, Ltd. (a subsidiary of English Electric) will in future be carried on by a new company with the above title, which will be owned equally by D. Napier & Son, Ltd., and Rolls-Royce, Ltd. It is intended that Mr. J. D. Pearson, deputy chairman and chief executive of Rolls-Royce, Ltd., shall become chairman of Napier Aero Engines, Ltd. The London factories of D. Napier & Son, which are principally engaged in aero engine work will be operated by the new company. D. Napier & Son, Ltd., will continue their other engineering business, and activities in the factories and establishments at Luton, Liverpool, and Netherton will not be affected.

Films on Human Relations in Industry

Typical situations that involve misunderstandings between factory employees and their supervisors are examined in six new 16-mm. sound films which have been added to the G.B. Film Library, 1 Aintree Road, Perivale, Greenford, Middlesex.

Designed for showing to industrial supervisory staff, these 8-minute films are based on actual instances which were reported by the Aluminium Company of America, and are intended to provide a basis for discussions on how the situations described might have been avoided.

The titles of the films are: "The Hidden Grievance," "Enforcing Rules and Procedures," "Personality Conflict," "Delegating Work," "The Trouble with Women," and "The Personal Problem."

New Astley Group Headquarters

Astley House, 33 Notting Hill Gate, W.10, the new London headquarters of the Astley Group of finance companies, was recently opened officially by Lord Rootes, who was introduced by the chairman, Colonel Sir Stanley Bell. Companies in the Astley Group, which is a member of the Finance Houses Association, include Astley Industrial Trust, Ltd., and the Astley Leasing Co., Ltd., and these two organizations provide, respectively, facilities for the hire purchase and leasing of industrial plant and equipment in all parts of the country. In his speech, Sir Stanley said that the leasing of industrial plant, which was already popular in America, offered advantages to both small and large firms, and it was intended to extend leasing facilities in the light of experience.

It is stated that a one-third interest in the Group is held by the District Bank, Ltd., and that the Pearl Assurance Co., Ltd., also has a substantial interest.

Scrap Metals

MIDLANDS.—The difficulties at present experienced in disposing of practically all grades of scrap are not likely to be lessened until well after the Midlands industrial holiday period has ended. Merchants are committed under contract to collect from local works and consequently such scrap is being stocked in preference to odd parcels which are on offer from casual suppliers.

One local steelworks has suspended deliveries of all grades until further notice and others are only accepting deliveries of No. 1 grade material under allocation until July 28.

Chipped and bushy steel turnings are being moved steadily, but larger tonnages are available than can be placed each week. For borings there appears to be a ready sale but during the next few weeks difficulties may arise in connection with the disposal of rail loaded material as consumers will not allow wagons to wait under demurrage.

Short heavy steel scrap is difficult to place, and prices are falling to nearer basic heavy steel levels for the poorer class of short material.

The cast iron market is very lively and restrictions will only be brought about by holiday closing. Broken cylinder iron is in keen demand in this area and prices have improved for complete loads of this type of iron.

Outlets for destructor bales are hard to find, and, together with other bundles, they are necessarily being stocked until after the holidays.

Oversize scrap for shearing and cutting by gas is acceptable at merchants' yards, but as immediate disposal of the processed scrap is out of the question at present there is a tendency for prices to ease by as much as 20s. per ton.

Progress in Precision

(Continued from page 179)

on two torsion bars by spiral springs can be varied by turning a frame to which the opposite ends of the springs are anchored, and it is stated that an angular movement as small as 0.02 sec. can be applied in this way. Finally, mention may be made of a requirement that a mirror on a slide must be parallel to a common plane within 0.05 sec., when the slide is in various positions. Because the degree of straightness of the guiding surfaces necessary to ensure this condition could not be achieved, provision is made for elastically deforming a support at one end of the bed to restore parallelism at any position.

It will thus be evident that the design and construction of this equipment has represented an important contribution, both directly and indirectly, towards greater precision. Not only will it enable line and end standards to be calibrated more accurately, but certain features will no doubt find application in other connections to enable the potentialities of these standards to be more effectively exploited.

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.



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These Swiss built machines are designed
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Pantograph ratios	50 : 1 — 1 : 1	50 : 1 — 1 : 1
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Work table	12in. x 6½in.	19¾in. x 9in.
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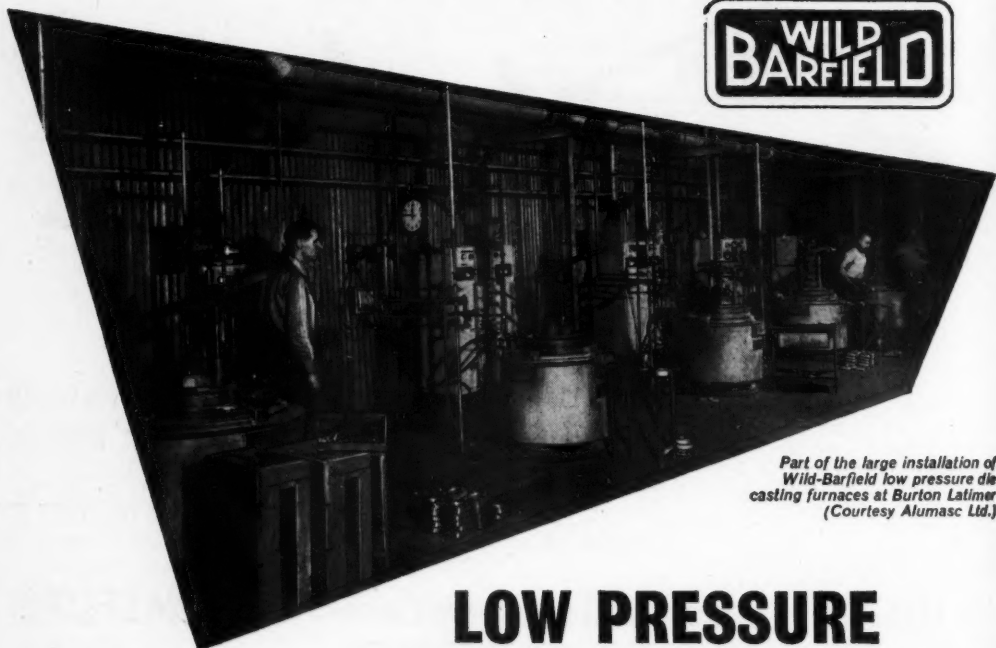
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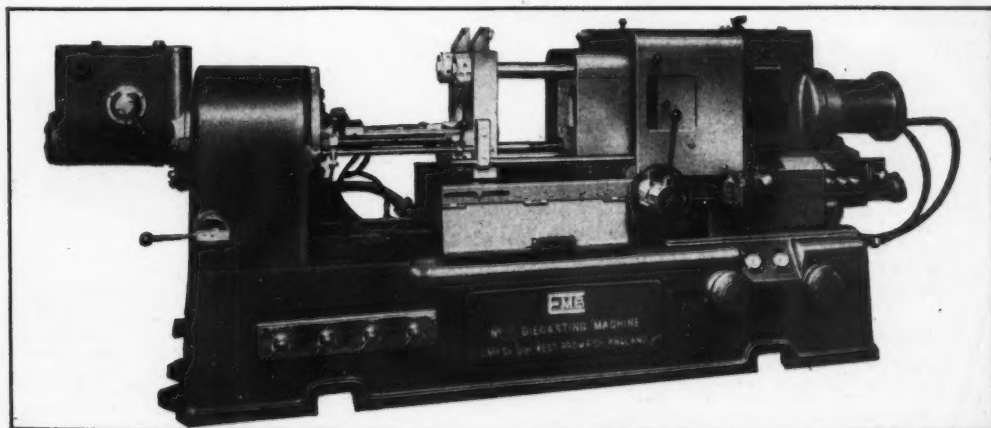
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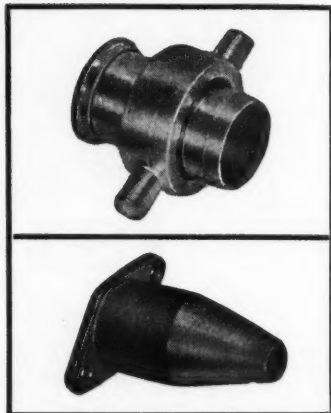
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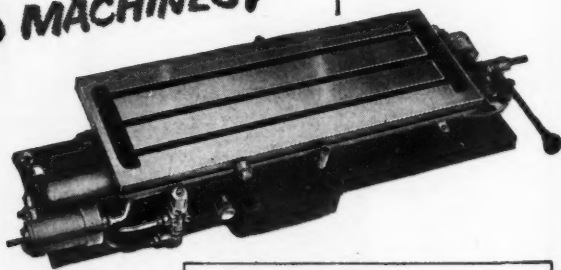
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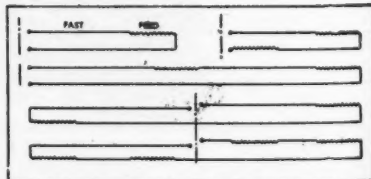
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Recommended air line pressure: 70/100 lb. per sq. in.

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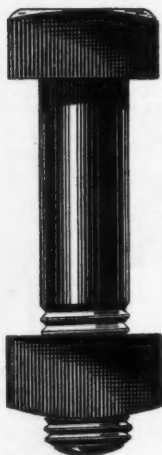
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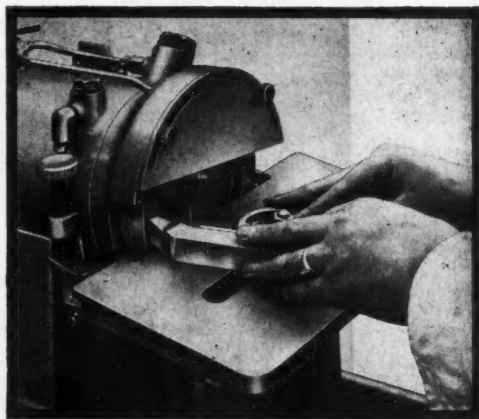


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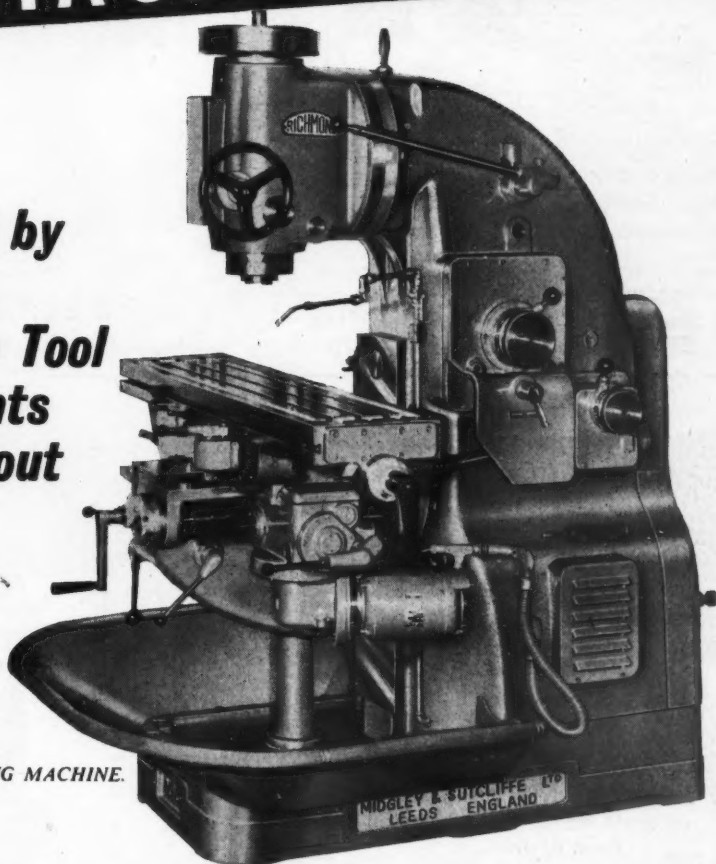
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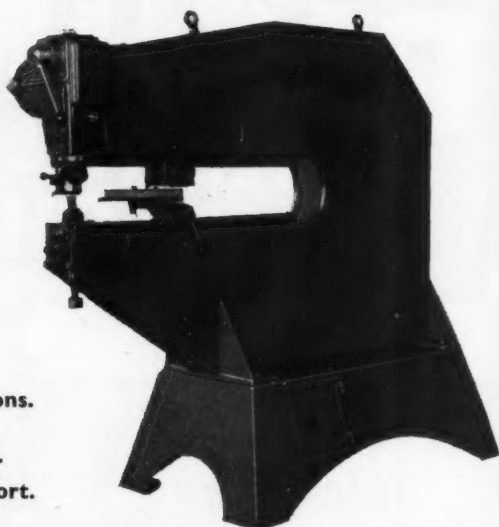
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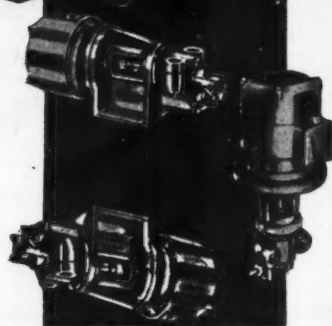
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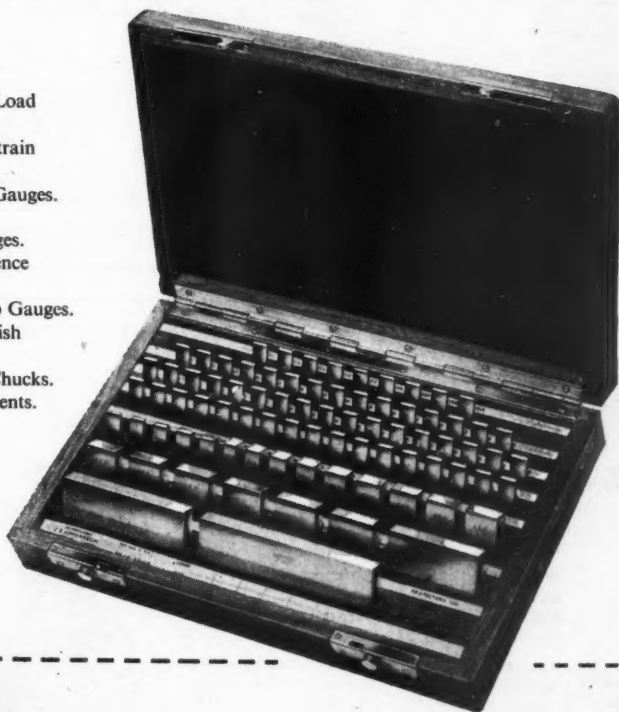
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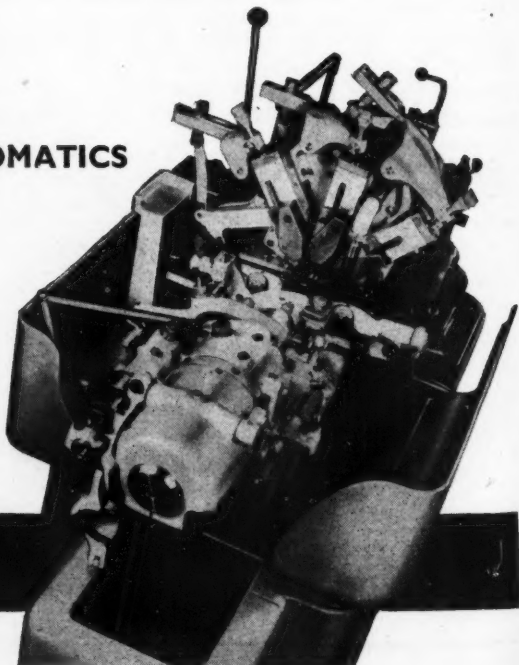
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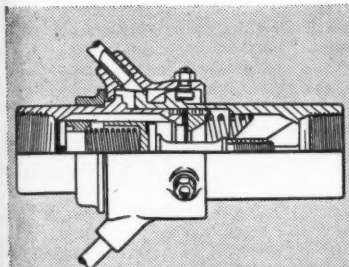
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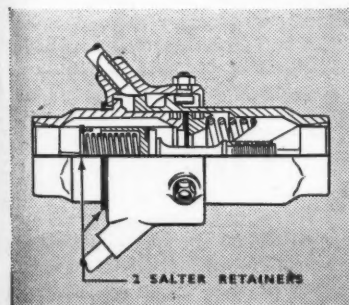
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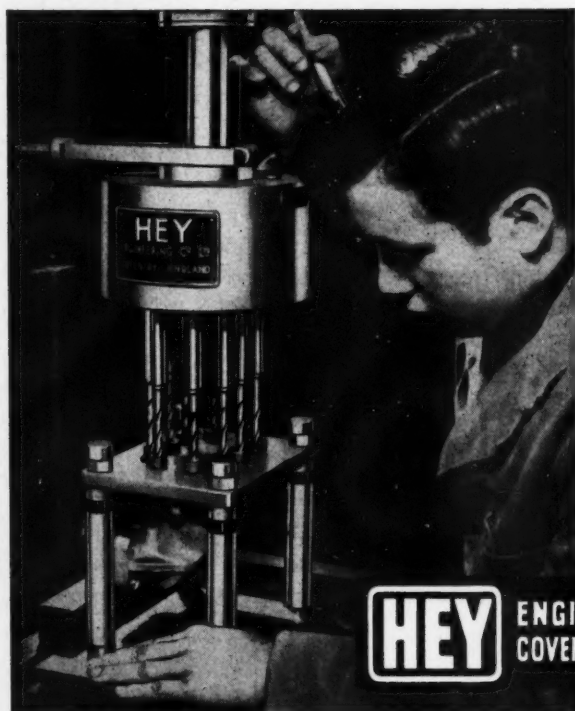
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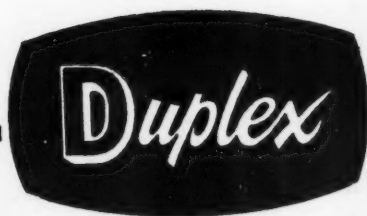
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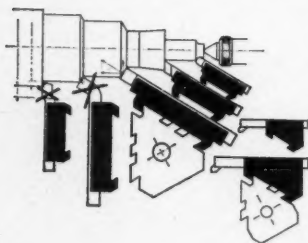
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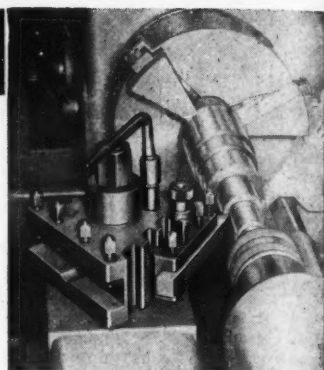
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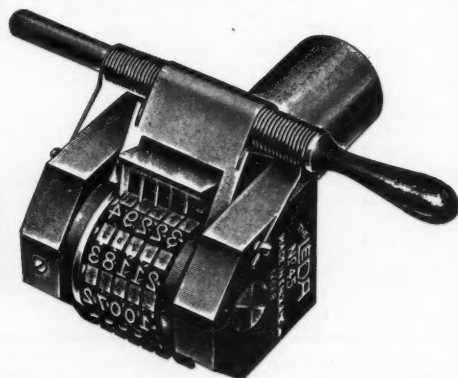
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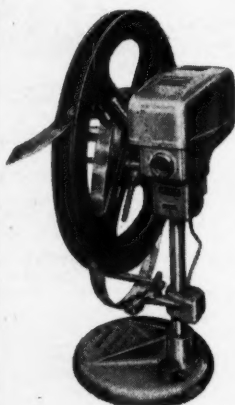
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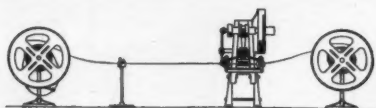
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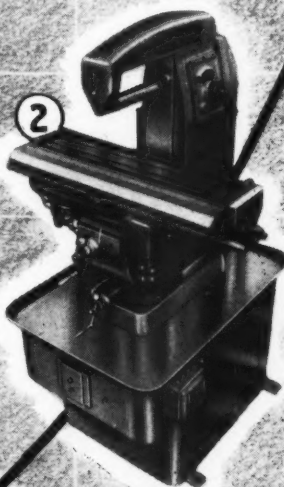
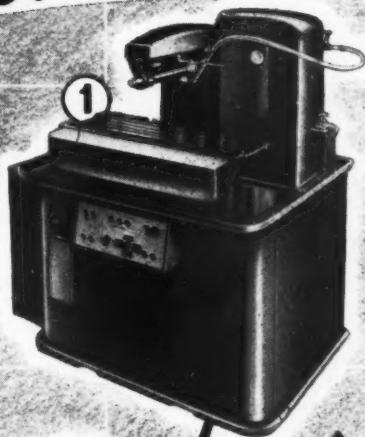
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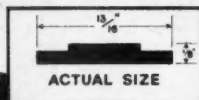
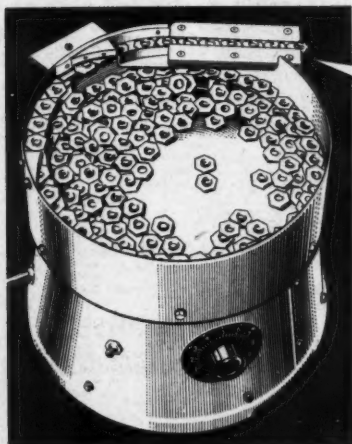
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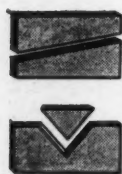
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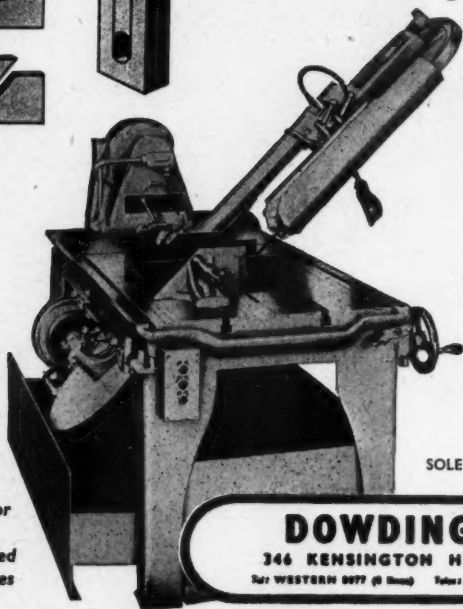


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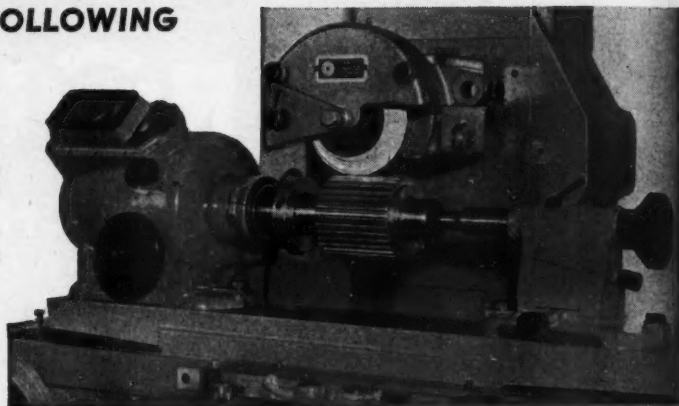
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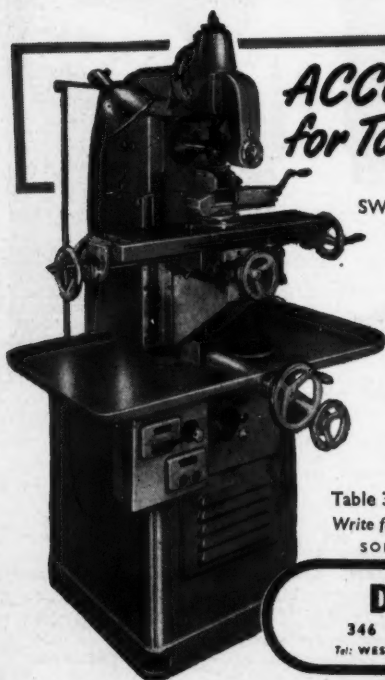
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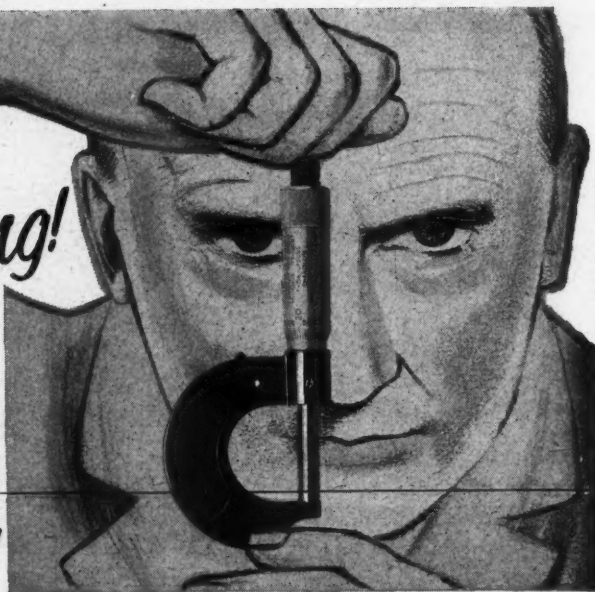
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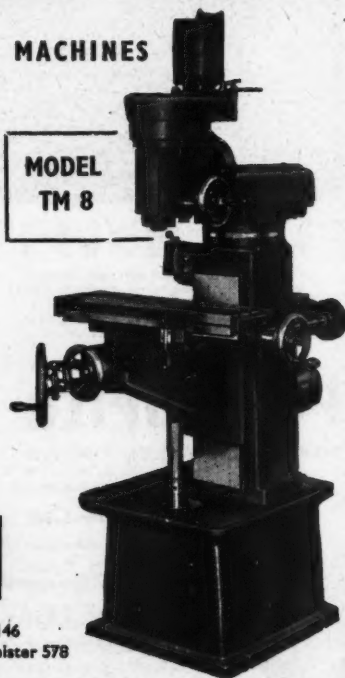
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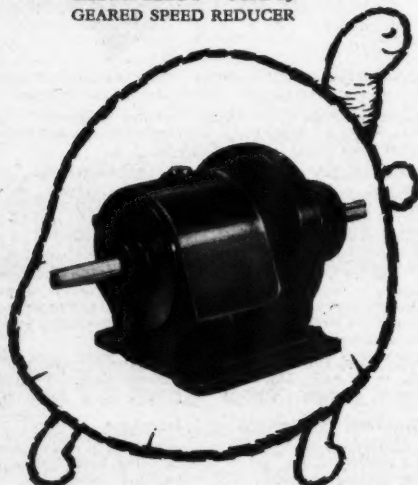
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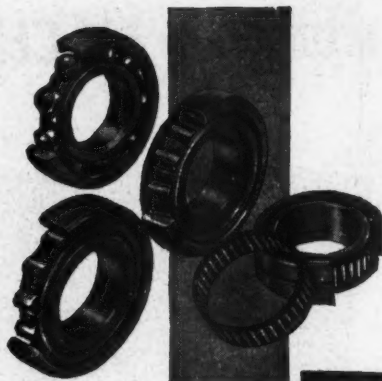
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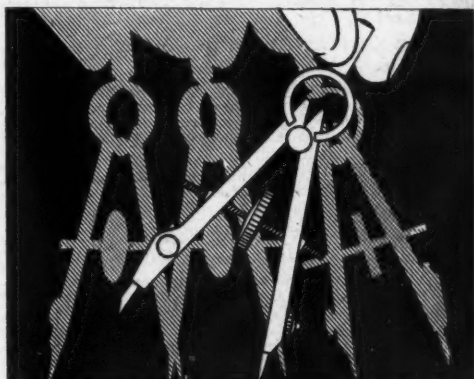


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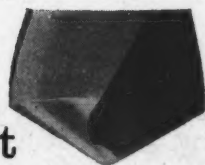
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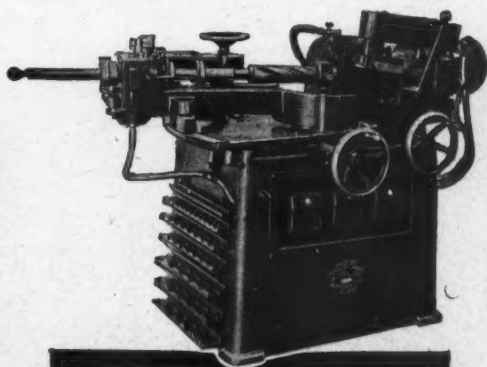
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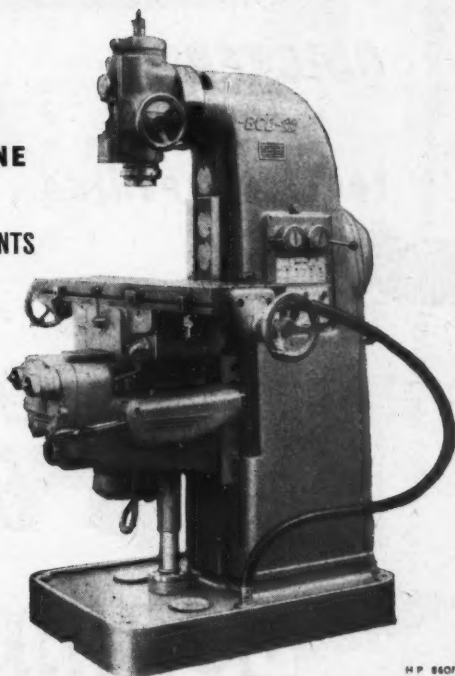
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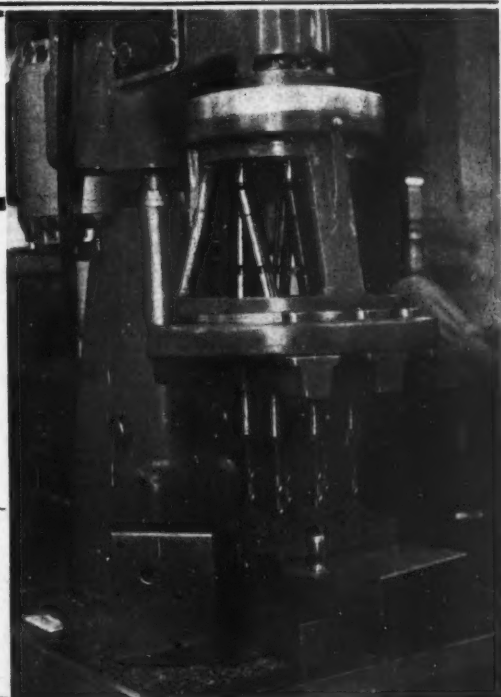
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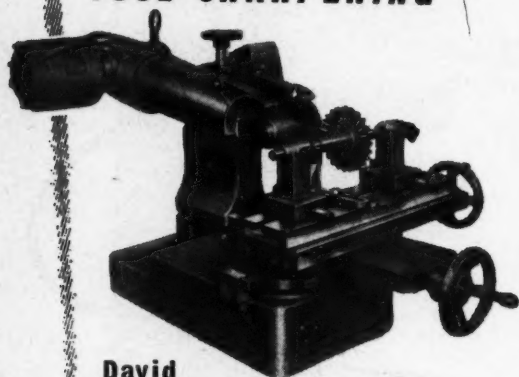
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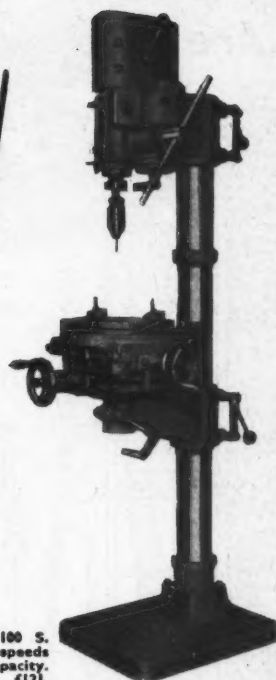
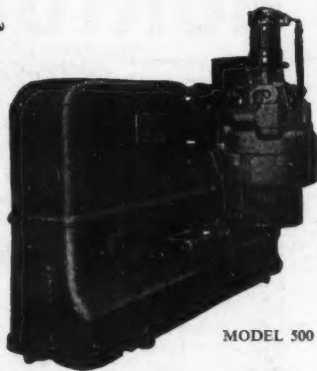
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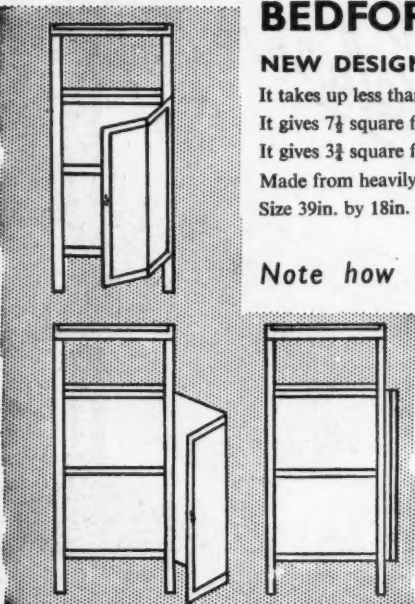
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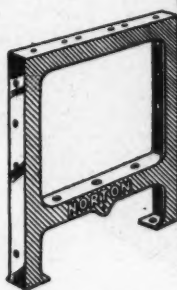
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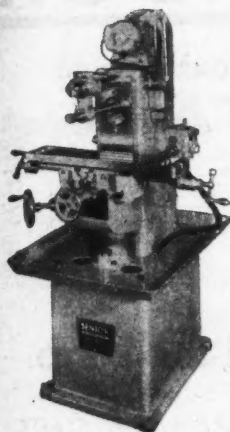
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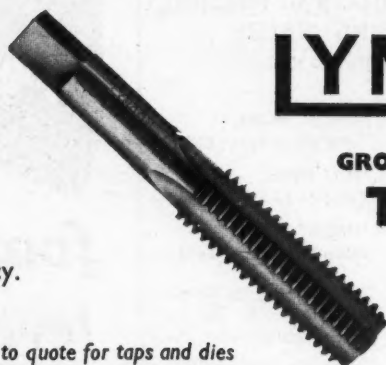
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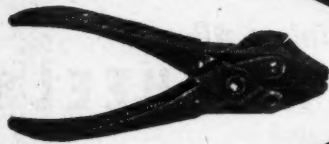
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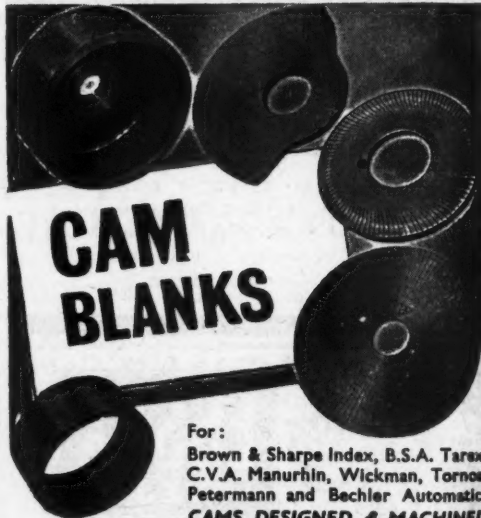
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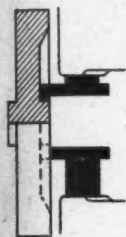
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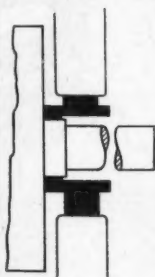
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MODEL 'D'

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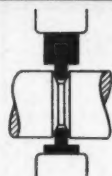
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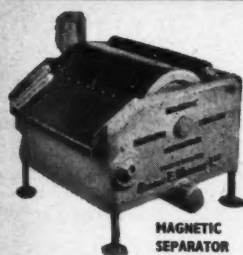
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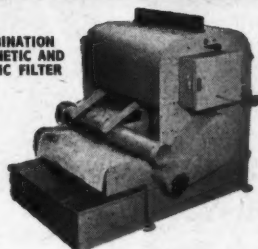
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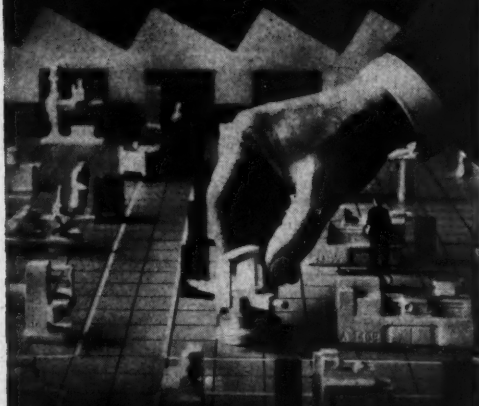
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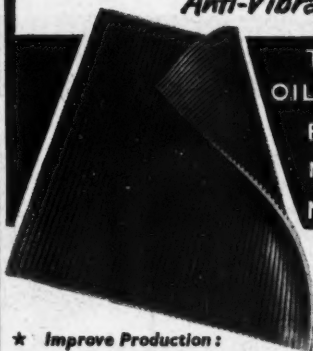
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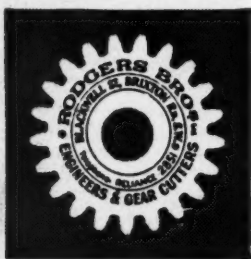
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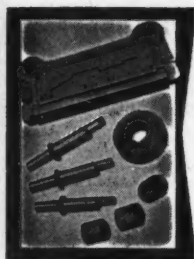
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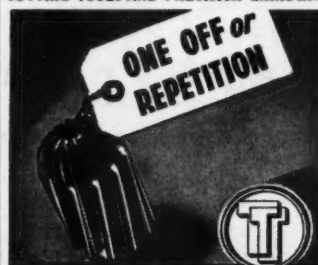
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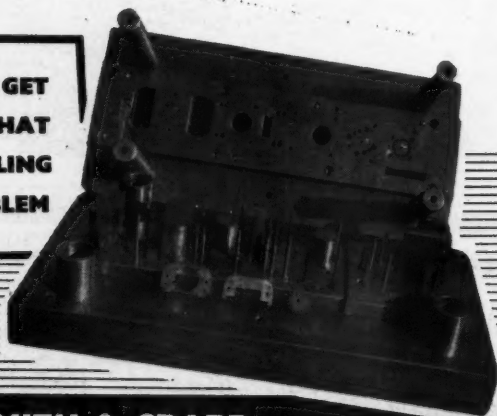
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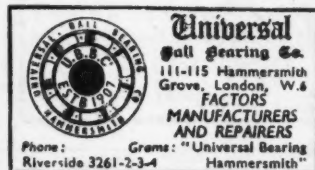
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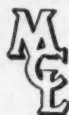
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When answering advertisements kindly mention **MACHINERY.**

Classified Advertisements (PLANT WANTED, contd.)

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79/89 PENTONVILLE ROAD
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Modern Vertical Spindle Surface Grinder,
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MUST be an U.S.A. built machine.
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12in. x 144in. **CHURCHILL** Cylindrical Grinding Machine, in good condition, 1956 machine, hardly used.

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DEAN, SMITH & GRACE straight bed Lathe.

All the above are modern machines motorised 400/3/50. Please send for our new Stock List.

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15in. Swing.
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Plano Milling Machine with
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6ft. by 4ft. by 4ft. Long.
SPEEDS 12 to 700 r.p.m.

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32in. Swing Gap Bed S.S. & S.C. Lathe.
10ft. Between Centres.

50in. by 16in. Swing in Gap.
Taper Turning Attachment.

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14 in. x 14 ft. Betts Bridgeford.
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Archdale 18 in., 40 in. x 10 in.
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Archdale 20 in.
Reiden H.F.30, 60 in. x 14 1/2 in.
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Ward 7 Capstan, covered bed.
Ward 7 Comb, covered bed.
Minganti 2A Comb.

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Brown & Sharp No. 2 Surface.
Robot No. 2.
J. & S. Univ. and T. & C.
Abwood Vertical Surface.

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C.V.A. 10 ton Dicing Press.
Rhodes Incl., 25 ton.
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Archdale 4 ft. Radial, 2 in. cap.
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Holroyd AN6 Thread Mill.
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All motorised 400/3/50.

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Machine Tools always in stock. At
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Press, 400/3/50 supply.

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Presses, 7 1/2 in. stroke, 50 tons. American.
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6 ft. x 1 in., motorised.

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1954. Can convert any span to 95 ft.

10 Ton Vaughan 42 ft. 3 in. span. Unused.

20 Ton Morris Goliath, 55 ft. span, 5 ton
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10 Ton Heywood, 34 ft. span. Unused.

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72 in. between centres. Swings 48 in. in gap.

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(Heavy Duty Type.)

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48 in. between centres. Swings 24 in. in gap.

All modern motor driven machines.

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BUTLER 36 in. OPENSIDE CRANK PLANING MACHINE

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4 1/2 in. x 12 in.

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We will rebuild your own machine
tools back to maker's specification with
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H.M.V. Horizontal Borer, Type A.V.75,
3 in. Travel Spindle.
KERRY Super 8 Pillar Drill.
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MACHINE TOOLS AVAILABLE FOR
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BUFFALO 28U Double Ended Punch,
Shear and Angle Cropper.
ASQUITH 6 ft. Radial Drill with screw
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MACHINES MOTORISED 400/3/50 UNLESS
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HAVE AVAILABLE FOR EARLY DELIVERY

One NEWALL No. 0 Jig Borer, fully rebuilt and carrying maker's guarantees.

Capacity: 18in. by 12in. Table 14in. Spindle Nose to top of table.

NEWALL 836 Thread Grinder.

NEWALL 10-U Lapping Machine.

No. 16 BLANCHARD Surface Grinder.

All ex rebuilt stock.

THE NEWALL USED MACHINE DIVISION OUNDLE ROAD ORTON LONGUEVILLE PETERBOROUGH

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Lorenz Gear Shaper, Model SOO.
Capacity 7 $\frac{1}{2}$ in. P.D. \times 21in. face. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. Northern 1234/5.

Two Surface Grinders, Surplus
to our production requirements. Beld 18 \times 6 Mechanical and Covel 24 \times 8 Hydraulic, only recently installed new.—BOX D119, MACHINERY, Clifton House, Euston Road, N.W.1.

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36in. \times 14g. Underside Gullotine.

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RICHARDS Horizontal Borer 2A, with facing head.
JUNGENTHAL Vertical Borer. Chuck diameter 39in., maximum swing 46in.

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ASQUITH 4ft. O.D.1 Radial Drill.
PROGRESS 5E Round Table.
ARCHDALE 28in. Heavy Duty Pillar Drill.

GEAR SHAPING
MODEL 61 FELLOWS Gear Shaper.
Straight spur 35in. dia. \times 5in. face width.

LATHES
WARNER & SWASEY No. 2A Long Bed.
SOUTHBEND 16in.

EDGWICK 7in.
DEAN, SMITH & GRACE. Height of centres 7in.

MONARCH 22M S.S. Taper Turning Lathe.
WARD 10 Combination Turret Lathe.

WARD 2A, with Ball Chuck and Bar Feed.
HERBERT 4 with Flamard bed, draw back chuck and Bar Feed.

MILLING
28in. **ARCHDALE**, Rapid all ways.
18in. **EDGWICK** Production Mill.
CINCINNATI No. 5 High Power Plain Hor. 1942 Machine.

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MILWAUKEE 2H Vertical—rebuilt.
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MILWAUKEE 3KM Universal, metric, with dividing head.

PEGARD Bed Type Vertical, table 84in. \times 29in.—slightly used.

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EDWARDS 6ft. \times 4in. Overcrank.

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VICTORIA U2 Universal Milling Machine.
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Heavy Duty Production **DRILLING MACHINES**, spindle No. 5 Morse taper; hydraulic movement to table and spindle head; speed 58 to 800 r.p.m.
36in. Elevating Arm **RADIAL DRILLING MACHINES**; spindle No. 4 Morse taper; swivel table; speed 60 to 500 r.p.m.
3 $\frac{1}{2}$ in. \times 14in. Capacity **UNIVERSAL GRINDERS**.

24in. \times 9in. Horizontal Spindle **HYDRAULIC SURFACE GRINDERS**.

12in. Centre **GAP BED LATHES**; 80in. between centres; speed 15 to 550 r.p.m.

VERTICAL MILLING MACHINES with swivel head; table 33 $\frac{1}{2}$ in. \times 10in.; speed 90 to 1,500 r.p.m.

TOOLROOM SLOTTING MACHINES 7 $\frac{1}{2}$ in. stroke; table 33 $\frac{1}{2}$ in. \times 10in.

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Telephone: EUston 5000. Telex. No. 24264

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KEARNS No. 4 Horizontal Boring Machine.

32in. Facing Head.

4in. Travelling Spindle.

Screwcutting.

Quartering table.

Motor driven.

First class condition. £3,250.

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ORONA 4 ft. Radial Drill. £325.**GRINDERS****JONES & SHIPMAN** 10 in. x 27 in. Universal
Grinder.
HERBERT HUNT Tap and Reamer. £65.
ROVER No. 1 Centreless, with auto feed.
SMART & BROWN Internal Grinder. 1 1/2 in.
Max.
NORTON 18 in. x 7 in. Hyd. Cyl. Grinder. £395.**LATHES****SOUTHBEND** 6 1/2 in. Lathe T/T.
JOHNSTAD 5 ft. 6 in. Facing Lathe.
MURAD 1 in. 3/4 Capstan, full equip.
DARLING & SELLERS 10 1/2 in. x 12 ft. T/T.
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OLDFIELD & SCHOFIELD 15 in. x 60 in. £250.
HERBERT SMALLPEICE 6 in. x 24 in. Multi-
tool.
NIVET Instrument Lathe, 4 1/2 in. x 24 in.**MILLERS (Vert. and Horiz.)****A KERSHAW** Vert. Mill 18 in. x 7 in.
RICHMOND 0.1 Horizontal 30 in. x 8 in.
CNTECO No. 3R Auto-cycle, pro mill.
KEY Duplex Spindle Mill. £175.
ADCOCK & SHIPLEY IVM Vert. 25 in. x 7 in.
As new.**POWER PRESSES AND SHEET METAL
MACHINES****ELMS** 250 ton Coining Press.
ELMS 213 60 ton geared. Adj. Str.
ELMS 203 20 ton Roll feed. Adj. Str.
RHODES 30 ton geared, adj. str.
BEBOO 20 ton.
WARD 20 ton.
TAYLOR & CHALLEN 10 ton.
EDGEMOND 12 ft. x 1/2 in. Folder.
BEBOO 10 ton Power Press. £175.
B.M.G. 9-ton Airdraulic. £200.**MISCELLANEOUS****BOTHIA** 5 ft. x 18 in. Planer.
RAPIDOR 3 in. x 6 in. heavy duty power saw.
MANUREHN TR12-16 1/2 in. Auto. 1968.
T.T. & H. Engraver CH with div. table.
MIDSAW 36 in. Bandsaw.
BARBER & COOLMAN 15 in. Hobber.
THIEL Filing and Sawing Machine. £95.
HURTE Key Sealing Machine. £225.
THIEL Punch Shaper.
ORMEROD 12 in. Shaper with Cam Cutting
Attach.
RAPIDOR 15 in. x 15 in. Filing and Sawing. £165.

Other machines in stock.

WE BUY**EXCHANGES
WELCOME****WE SELL****HIRE PURCHASE
ARRANGED****GEAR CUTTING MACHINES****MATTHEWSON** 12 in. Bevel Gear Generator
for use with Shaping Machine. AS NEW.
£300.**J. E. RAISTRICK LIMITED,**
RELIANCE WORKS,
POYLE TRADING ESTATE,
COLNBROOK, SLOUGH, BUCKS.
Tel.: Colnbrook 2421.**THE SPOT TO WATCH!**

FOR GOOD CLASS SECONDHAND MACHINES AT LOW COST

B.S.A. No. 48 Automatic.
BROWN & SHARPE '00' Automatic.
HERBERT 48S Capstan.
WARNER & SWASEY No. 2 Capstan.
JONES & SHIPMAN 4 Spindle Drill.
HERBERT 4 Spindle Drill.
CORONA 2 Spindle Drill.
LANDIS 4 in. by 18 in. Plain Grinder.
B.S.A. No. 7 Centreless Grinder.
SCRIVENER ICA Centreless Grinder.
PRECIMAX 6 in. by 12 in. Plain Grinder.
NEWALL Thread Grinder 8 in. by 36 in.
MYFORD M.G.9 Uni. Grinder.
ESSEX Centreless Grinder.
ABWOOD Surface Grinder. Vert. Sp.
BROWN & SHARPE No. 11 Grinder.
LEBLOND No. 15 R.P. Lathe.
HOGARTH S.S. Lathe.
D.S. & G. 13Z Lathe.
HERBERT ND Lathe.
SOUTHBEND 10 in. Lathe.
ADCOCK & SHIPLEY No. 3 Hor. Mill.**MILWAUKEE** Simplex 12/24 Mill.
CINCINNATI Model 08 Vertical Mill.
MILWAUKEE 4H Uni. Mill.
MILWAUKEE 2HL Hor. Mill.
CLEVELAND Vertical Mill.
ARCHDALE 18 in. Vertical Mill.
REED PRENTICE 3VG Vert. Mill.
KELLER 1210 Diesinking Machine.
KITCHEN & WADE No. 2 Honing Machine.
SENTINEL 25T Power Press.
ORMEROD 4 in. Slotter.**LATE AMERICAN MACHINES****GLEASON** 3 in. Str. Bevel Gear Generator.
GLEASON 12 in. Str. Bevel Gear Generator.
FELLOWS 7125 High Speed Gear Shaper.
FELLOWS No. 7 High Speed Gear Shaper.
FELLOWS 61A High Speed Gear Shaper.
HEALD 72A3 Internal Grinder.
GLEASON No. 16 Spiral Bevel Hypoid
Gear Generator.

All machines motorised 400/3/50 unless otherwise stated.

GOOD USED MACHINE TOOLS WANTED**E. H. JONES**
MACHINE TOOLS LTD.**48 HIGH STREET,
EDGWARE, MIDDXX.**
PHONE EDGWARE 4488/9

75, WRENTHAM STREET, BIRMINGHAM 5, Phone Midland 5593

**NEW MACHINES
EX-STOCK****RICHMOND** SR2 Radial Drill,
1 1/2 in. by 3 ft. arm.
CENTEC 2B Miller, 25 in. by 5 in.
table. Pedestal type with power
feed.
GRIMSTON 1 1/2 in. Pillar Drill
LEC, 8 speeds.
VICEROY Screwcutting Lathe PCS,
4 1/2 in. centre height. Cabinet
model.
G. & S. Sawmaster Hacksaw, with
suds equipment.
PACERA MF2RC 1/2 in. Drill, with
Lo-volt and overload release
starter.**MACHINES FOR
EARLY DELIVERY****VICTORIA** U2 Miller, 45 in. by
11 in. table (AUG.).
HARRISON Miller, 30 in. by 8 in.
table (NOV.).**JAMES W. CARR & Co. Ltd.,**
7/15 ROSEBERY AVENUE
LONDON E.C.1

Tel.: TERMINUS 8866 Ext. 4

**NEW SURPLUS STOCK
B.S.F. SOCKET HEAD CAP SCREWS**
Unbrako and G.K.N.8,000 of each size 1/2"x1/4", 3/8"x1/4", and
Keen prices quoted.1/2"x1/4" Ex. stock.
WM. HURLOCK JNR. LTD. (Estab. 1904)
5-7 Kingston Hill, Kingston-on-Thames
Surrey. KIN 4524-7-8**LEONARD ROTH****ABBOT ST., KINGSLAND HIGH ST.****DALSTON JUNCTION,
LONDON, E.8****TERMS ARRANGED**
Tel. CLIsold 0518/4***CARDIFF** 7 in. Centre Lathe, 36 in. b.o.,
3 and 4 jaw chucks, faceplate, etc.
£450.
***BURNS & BERRY** 9 in. Centre Lathe, 9 ft.
b.o., 2 in. h.m., swings 32 in. in cap.
Norton quick-change box, steadies
chuck, etc. £225.
***DEAN, SMITH & GRACE** 6 1/2 in. x 36 in.
Centre Lathe, 3 and 4 jaw chucks. £275.
NORTON No. 6 Deep Throat Fly Press.
£55.
DENBIGH No. 4 Fly Press on stand. £18.
SMART & BROWN Tonsie Press. £20.
***SMART & BROWN** 4 in. Precision Centre
Lathe with chuck and collets. £78.
***AEROGRAF** Compressor, 15 c.f.m.
(Reconditioned.) £95.
***AIR PUMPS** Compressor, approximately
12 c.f.m. £85.**ALL MACHINES MARKED * ARE
MOTORISED 400/3/50**
PLEASE WRITE FOR LISTS**"Alldays & Onions" 2-Cwt.**Pneumatic Power Hammer for sale.
Overhanging type without slides. Length of
stroke 14 in. Size of bar worked 4 in. diameter.
Diameter of ram 9 1/2 in. Arranged motor drive
440/3/50. Complete with anvil. Weight about
50 cwt.—F. J. EDWARDS LIMITED, 359,
Euston Road, London, N.W.1, or 41, Water
Street, Birmingham, 3.

When answering advertisements kindly mention MACHINERY.

Classified Advertisements (PLANT FOR SALE, contd.)

WIDDOWSON'S

PENSOTTI Model KTV1050 Turret Type Single Column Vertical Boring and Turning Mill. With sidehead. To swing 43in. dia., admit 32in. under cross slides, 20 h.p. motor

JONES & SHIPMAN Model 921 Heavy Duty Pillar Drilling and Tapping Machine. No. 5 M.T.

DEMM Model S.18-750 Gear Shaping Machine

REINECKER Model SSM3 10ft. Heavy Duty External and Internal Spur Gear Shaping Machine. 6 1/2in. face width.

NORTON Model C Hydraulic Plain Cylindrical Grinding Machine, 15in. swing, 8ft. 6in. between centres.

KAESER (Swiss) Hydraulic Plain Cylindrical Grinding Machine. Two machines available. Capacity 6in. x 36in. and 10in. x 20in. Both in excellent condition.

CHURCHILL Model VB Slideway Grinding Machine, 72in. x 34in. x 36in. Excellent condition.

SCULFORD FOCKEY 12in. Centres High Speed Gap Bed S.S. & S.C. Lathe, 14ft. between centres.

OLDFIELD & SCHOFIELD 32in. Swing Gap Bed S.S. & S.C. Lathe, 10ft. between centres, swing in gap 50in. x 16in. Taper turning attachment.

MITCHELL 8 1/2in. Centres Gap Bed S.S. & S.C. Lathe. Several available. All As New. 52in., 54in. and 64in. between centres.

WARD No. 13 Combination Turret Lathe, covered bed, 25in. concentric chuck, 27in. 4-jaw independent chuck. Good turret tooling, taper turning attachment, 35 h.p. motor, 400/3/50. Modern machine. Excellent equipment.

KENDALL & GENT 6ft. x 4ft. x 4ft. 6in. Plano Milling Machine. With vertical head 27 spindle speeds 12 to 700 r.p.m., 9 feeds to table.

CINCINNATI Hydromatic 56-72 Hydraulic Plain Horizontal Production Milling Machine. Table 103in. x 26in., speeds 24 to 179 r.p.m.

CINCINNATI Model 4HP Heavy Duty Vertical Milling Machine. Table 72in. x 19in., speeds 17 to 480 r.p.m.

ORMEROD 20in. Stroke Pedestal Type Shaping Machine. 9 speeds 9 to 104 s.p.m., 5 h.p. motor. Two machines available.

MASSEY 2-cwt. Pneumatic Power Hammers, 14in. stroke, 200 blows per minute, 10 h.p. motor.

HERBERT

WIDDOWSON

& SONS LTD.

CANAL STREET, NOTTINGHAM

'Phone: 51891

ACBARS LIMITED, 331-3, WALWORTH ROAD, LONDON, S.E.17.

Telephone: RODney 7822.
Telegrams: Acfirb London S.E.17.

AVAILABLE FROM STOCK

All machines listed below are at our Works in Sutherland Walk, Walworth Road, S.E.17

AUTOMATICS

HERBERT Auto Junior.
RYDERMATIC No. 12 Vertical Multi-Tool Lathe.

BROACH

FORST RIAS Universal Vertical Broach for internal and surface broaching. 5 tons, 39 1/2in. stroke. 1952 machine.

GRINDERS

BROWN & SHARPE No. 2 Surface. New ALFA Surface, 32 x 8in.
JUNG AS Internal.
KEIGHLEY Type XL Hydraulic Plain Grinder, 6in. x 18in.
CHURCHILL 10in. x 24in. Universal.
LANDIS 12 x 48 Universal.
BROWN & SHARPE No. 3 Universal.
NORTON 14in. x 36in. Universal.
New **BAMKIN** Tool and Cutter.

CAPSTAN AND TURRET LATHES

LEICHTI PR Turret Lathe (Swiss).
GISHOLT IL Turret Lathes.
FOSTER No. 2B Turret Lathe.

CENTRE LATHES

SMART & BROWN Type M 4in. Precision.
HENDEY 6in. x 30in. Taper Turning.
MONDIALE 7in. x 60in. Gap Bed.
CROMWELL 3 1/2in. Precision.

MILLERS

WERNER No. 5160 Small Multipurpose, Vert. and Horiz. Table 22in. x 64in.
ARCHDALE 14in. Manufacturing type.
CINCINNATI Type OK 18in. Horiz.
EDGWICK 18in. Horizontal.
ARCHDALE 20in. Twin Overarm Horizontal. Table 40in. x 10in.
KENT-OWENS I-8 and I-14 Hydraulic Production.
New **TAYLOR** Vertical, table 17 1/2in. x 5 1/2in.
HERBERT 23V Vert. Table 68in. x 17in. 48in. traverse.
REED PRENTICE No. 6 Vertical. Table 84in. x 20in.
HELLER Automatic Thread Millers (4).
ASQUITH HKO Duplex Keyseater.

PRESS

V. & O. No. 11 Double Action. Approx. 10 tons. Roll feed. Max. draw 1in.

All machines motorised 400/3/50 unless otherwise stated.

MILLING MACHINES

CINCINNATI No. 3 Vertical, 53in. x 15in' Dial Type. Price on application.
BIERNATZKI Vertical H.4, 73in. x 18in. £350.
DENBIGH Horizontal, 40in. x 10in. £90.
HERBERT No. 5 Vertical. £675.
BROWN & SHARPE 2YB, 34in. x 11in. £185.

J. E. RAISTRICK LIMITED,
RELANCE WORKS,
POYLE TRADING ESTATE,
COLNBROOK, SLOUGH, BUCKS.

Tel. Colnbrook 2421.

Cashmores

**Selections of Machine Tools
from Stock or Early Delivery**

DRILLING MACHINES

New **KITCHEN WALKER** 8ft. E. 3 Radial Drilling Machine, No. 5 M.T. spindle.
ASQUITH LDR 4ft. 6in. Radial Drilling Machine, No. 4 MT spindle.
KITCHEN & WADE 8ft. Gilder Type Radial Drilling Machine, 18 spindle speeds, 6 feeds. No. 5 M.T. spindle, motorised 400/3/50 supply.

BORING MACHINES

WEBSTER & BENNETT Series 1D 36in. Single Column Type Vertical Boring Mill, motorised 400/3/50 supply.

SLOTING MACHINES

ORMEROD 12in. stroke Slotting Machine, 27in. dia. rotary table, motorised 400/3/50 supply.

LATHES

COLCHESTER 8 1/2in. Mascot S.S. & S.C. Gap Bed Lathes, to admit 6ft. 6in. between centres.
WILLSON 7 1/2in. S.S. & S.C. Lathe, to admit 3ft. between centres.
GRAVEN 15in. S.S. & S.C. Lathe, to admit 10ft. between centres.
DEAN, SMITH & GRACE Surfacing and Boring Lathe, with hexagon turret, swing over bed 24in., swing in gap 36in.
LANG 12 1/2in. Gap Bed S.S. & S.C. Lathe, to admit 10ft. 6in. between centres.
GRAVEN 15in. S.S. & S.C. Lathe, to admit 25ft. between centres. Two Saddles.
LANG 15in. Centre Lathe, two saddles, admit 17ft. 6in. between centres, motorised 400/3/50 supply.

MILLING MACHINES

C.V.A. "Kearney & Trecker" model 2E Dia. Type Horizontal Plain Milling Machine, working surface of table 41in. x 12in., longitudinal feed 29in., cross feed 12in., 8 spindle speeds 25/1,000 r.p.m., motorised 400/3/50 supply.
CINCINNATI Model 3/36 Hydromatic Milling Machine, table 54in. x 14in., motorised 400/3/50 cycles.

BROACHING MACHINE

CINCINNATI 10 ton Vert. Single Ram Hydraulic Surface Broaching Machine, 66in. stroke, 20in. x 20in. table, motorised 400/3/50 cycles.

GRINDING MACHINES

JONES & SHIPMAN 8in. x 16in. Tool and Cutter Grinding Machine.
CHURCHILL 16in. x 36in. Model PBH Universal Grinding Machine, with hydraulic feed and internal grinding attachment.
JONES & SHIPMAN 10in. x 27in. Horizontal Spindle Hydraulic Surface Grinder.

PLANING MACHINE

STIRK 10ft. x 4ft. 6in. x 4ft. 6in. "Hilopool" Double Column Planing Machine, with four toolboxes, Stirk Split Field Motor Drive.

POWER PRESSES

One New **PEARSON** 75 ton Hydraulic Press Brake, 9ft. x 4in. capacity, motorised 400/3/50 cycles.
New **BUTTERLEY** No. 4, 20 Ton Ungeared Power Press, 1in.-3in. adjustable stroke.

SAWING MACHINES

NOBLE & LUND 24in./28in. Cold Circular Sawing Machine, 10in. dia. rounds, 9in. squares, 18in. x 7in. seams, motorised 400/3/50 cycles.

SCREWING MACHINES

KENDALL & GENT 3-2 Tangential Head Screwing Machine, to screw bolts up to 2in. outside diameter, tubes up to 3in. inside diameter, machine fitted with lead screw motorised 400/3/50 supply.

MISCELLANEOUS

CLYDE 10 ton Overhead Electric Travelling Crane, 52ft. 3in. span.

All the above machines are motorised 400-440/3/50 cycles.

JOHN CASHMORE LTD.,
GREAT BRIDGE, STAFFS. Tel.: Tipton 2181/7.

(Also at NEWPORT, MON.)

When answering advertisements kindly mention MACHINERY.

R. O. GRAY

TWO WARD 2A Capstan Lathes. Both equipped ball chuck and bar feed.

TWO WARD 3A Capstan Lathes. Both equipped ball chuck and bar feed.

DRUMMOND Model K Capstan Lathe, arranged for chucking. 2½ in. Hollow spindle.

HERBERT No. 7 Junior Combination Turret Lathe. Flamard bed.

ONE HERBERT 2B Capstan Lathe, arranged for chucking.

HERBERT 1S Capstan Lathe, part bar feed.

TWO MOREY 2G Capstan Lathes, arranged for chucking.

INDEX No. 36 Single Spindle Automatic.

HERBERT 1½ in. Single Spindle Bar Automatic, with equipment.

DEAN, SMITH & GRACE, A.N. Type, 7 in. by 4 ft. between centres S.S. & S.C. Gap Bed Lathe. 2 in. H.S. Swing in gap 24½ in. by 7½ in.

CARSTENS 4½ in. by 20 in. between centres S.S. & S.C. High Speed Precision Lathe, fully equipped with collets, chucks, etc.

CHURCHILL-CUB 5 in. by 20 in. between centres S.S. & S.C. Lathe, with chucks, pick-off gears.

KEARNS No. 2 Horizontal Boring and Facing Machine, with Vernier Height Gauge and Boring Bars.

PEARNE-RICHARDS No. 2 Horizontal Boring and Facing Machine. With Vernier Height Gauge and Boring Bars.

KEARNS No. O.A. Production type Horizontal Boring Machine with 2 in. dia. traversing spindle.

KITCHEN & WADE Heavy Duty Pillar Drill. Spindle bored No. 4 M.T. Rise and fall table 24 in. dia., swings round column.

ARCHDALE Two-Spindle Relieving Drill, No. 1 M.T. Power feed and independent motor drive to each spindle. Table W.S. 36 in. by 15 in.

TWO HAHN & KOLB Two-Spindle Drilling Machines. Power feed and independent motor drive to each spindle, fitted ½ in. drill chuck. Table W.S. 21½ in. by 9 in.

DISKUS Vertical Spindle Surface Grinder, hydraulic feeds. Table 53 in. by 10 in. 14 in. dia. segmental wheel.

CHURCHILL Model "O" Universal Tool and Cutter Grinder, capacity 8 in. by 16 in.

EDGWICK No. 1 Keyseating Machine.

DAVID BROWN Worm Shaft Milling Machine, 4 in. centres by 33 in. between centres.

BROWN & SHARPE No. 2 Universal Milling Machine. Table W.S. 46 in. by 10 in. Spindle speeds 30-1,300 r.p.m. With high speed Vertical Milling Attachment, Slotting Attachment, Universal Dividing Head, chuck, change gears, rotary table, etc.

THREE HERBERT O.V. Vertical Milling Machines, swivel head. Table W.S. 18 in. by 5 in. Spindle speeds 250-2,000 r.p.m.

TRIDENT V.O. Swivel Head Vertical Milling Machine. Table W.S. 30 in. by 8 in. Spindle speeds 130-800 r.p.m.

ARCHDALE 20 in. Plain Horizontal Milling Machine. Table W.S. 10 in. by 31 in. Dial change.

EDGWICK 18 in. Plain Horizontal Milling Machine. Table W.S. 26 in. by 7 in. Spindle speeds 30-600 r.p.m.

ASQUITH Two Spindle Profile Milling Machine. Capacity 24 in. by 28 in. Spindle speeds 250 to 3,000 r.p.m.

WOTAN 16 in. Crank Shaping Machine.

ALBA 18 in. Crank Shaping Machine.

THIEL No. 6 Radial Arm Tapping Machine, capacity ½ in. Whit.

JONES & SHIPMAN "Electrotap", with quantity of leaders.

SIX TURNER Spin Rivetting Machines, type R.S.5.

CANNING Centreless Polishing Machine, with motorised dust extractor.

EDWARDS 4 ft. by 14 g Power Guillotine.

TAYLOR & CHALLENGE 10 Ton Inclined Blanking Press, ½ in. stroke.

PFAUTER R.S.1. type Vertical Gear Hobber.

PFAUTER R.S.11 Horizontal Gear Hobber.

All machines self-contained drive. 400/440 volts, 3 phase, 50 cycles.

R.O. Gray

4/6 MINERVA ROAD, PARK ROYAL, LONDON, N.W.10

Telephone: ELGar 4841/4842

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Classified Advertisements (PLANT FOR SALE, contd.)

PIDGEN BROS. LIMITED

HELMET ROW, OLD STREET, LONDON, E.C.1

Telephone: CLerkenwell 6481

ALL MACHINES MOTORISED FOR 3 PHASE SUPPLY UNLESS OTHERWISE STATED

AUTOS

GREENLEIGH 1in x 6 spindle.

BENDING MACHINES

KENNEDY 3A Power, 2in. type.

BORERS (Horizontal)

KEARNS No. 2.

BROACHING

AMERICAN Model H2, stroke 30in.

CAPSTANS

PITTLER TYPE RGII 82.

MURAD 3in.

HERBERT 4B and 4.

DRILLS

NATCO 24 spindle No. 1 M.T.

CORONA Type 15CX 2 spindle.

HERBERT 2 spindle.

MONMOUTH 4 spindle, No. 2 M.T.

ARCHDALE 3ft. Radial No. 3 M.T.

DENBIGH 24in. B.G.

HERBERT "C" Power Feed.

CORONA No. 21 AR, No. 3 M.T.

JONES & SHIPMAN 816, 1/2in. cap.

CORONA IAX, No. 1 Morse Taper.

LELAND GIFFORD 2-sp., No. 2 M.T.

HERBERT Type B, Single Spindle, 1/2in.

CORONA 6MX Cluster Type.

HERBERT Type H, 1/2in. cap.

CORONA 12AX, 1/2in. cap.

ENGRAVERS

ALEXANDER No. 2, 3-dimensional.

LIENHARD 3-dimensional. (New.)

LIENHARD No. 1H.

HUPFIELD Router.

T.T. & H. Type C, and M.A.

T.T. & H. Multi Etcher.

FILING AND SAWING MACHINES

JONES No. 13 Bandsaw.

WICKSTEAD No. 1 Hacksaw.

RAPIDOR 6in. Hacksaw.

RAPIDOR Filing.

FOLDERS

Sheet Edging, 30in. x 22g.

GEAR CUTTERS

SAFAG Pinion.

MAXICUT 7in. x 2in. x 6 D.P.

PETERMAN No. 1 and 2.

GRINDERS (Internal)

CHURCHILL HBY.

BRYANT 16/38 and 5.

GRINDERS (Surface)

CHURCHILL OSB 8in. x 30in.

LUMSDEN Vert. 210 XXM.

SNOW Table, 20in.

ABRASIVE No. 34 Vertical Spindle.

GRINDERS (Cylindrical)

CHURCHILL 6 x 36in. B.Y.

CHURCHILL PBH 12 x 36in. Uni.

NEWALL 6 x 18. Model XL.

GRINDERS (Miscellaneous)

FIRTH BROWN 1-1/2in. Drill.

JONES & SHIPMAN, 10in. x 27in. T. & C.

J. & S. Drill, 1/2in. to 1in.

STEDALL WUNDERLI Carbide.

ROWLAND 12in. x 2in. Single Wheel.

WICKMAN NIVEN Carbide.

WADKIN Saw Sharpener.

JACKMAN D/E 18in. Disc.

EXCEL Model OS. T. & C.

TURNER 14/20 20in. x 3 1/2in. wheels C/E.

NEWALL 420 Univ. Threads.

HUNT No. 0 and 1 Tap Regrinders.

HUNT No. 0 and 2 Drill.

CHURCHILL Valve.

HONER

DELAPENA 4-speed.

KEYSEATERS

BENTLEY 5in.

ASQUITH H.K.O. Horiz. Duplex.

EDGWICK 4in.

LATHES

DEAN, SMITH & GRACE 7in. S.S. & S.C.

CHURCHILL Cub, 6in. x 24in. S.S. & S.C.

SOUTHBEND 13in. S.S. & S.C.

DENHAM 4 1/2in. x 24in. S.S. & S.C.

LE BLOND Production, 11in.

RIVETT S.S. & S.C. 4in. Model 602.

SOUTHBEND 10in. Toolroom.

WILLSON 7 1/2in. S.S. & S.C.

MONARCH 10EE x 22in. S.S. & S.C.

SMALLPIECE 9SVW Multi-tool.

RIVETT 3 1/2in. Plain. Model 715.

WARD, HAGGAS & SMITH 8 1/2in. x 78in.

RYDERMATIC No. 12 Multi Tool.

BERRY 6 1/2in. S.S. & S.C.

MISCELLANEOUS MACHINES

LUKE & SPENCER 38in. x 4 HP Polisher.

CANNING 5 1/2in. x 2 HP Polisher.

Dust Extractors, Various.

MILLERS (Horizontal)

DENBIGH C4.

CINCINNATI O8 Production.

CINCINNATI 1/18 Production.

ROSCHER EICHLER. Table 39in. x 12in.

ST. ANDREA Model UFO3. Table 57 x 14.

KENT OWEN 1/8 Production.

HARDINGE Precision. Table 25 x 6 1/2.

WERNER. Table 14 x 5.

JONES 225 Univ. Table 22 x 6.

ARCHDALE 20in. dial and 14in. mfg.

RICHMOND O3. Table 40 x 10.

U.S. Multi Mill. Production.

MILLERS (Vertical)

REED PRENTICE No. 2.

BROWN & SHARPE No. 2 Light.

C.V.A. 79 Tool and Die.

REED PRENTICE No. 5, 68in. x 16in. table.

WADKIN Type LXIA. Table 36in. x 13in.

PRESSES (Power)

BESCO BA 20. Adj. Str.

BLISS No. 18. Adj. Str.

BLISS No. 16 Bar.

LEORA No. 8. 4 tons.

WRIGHT Clicking Press.

PROFILING MACHINE

CURDNUBE 2 Spindle. Model KIV.

RIVETERS

HIGH SPEED Hammer, 7/16 cap.

TURNER RH18 (1/2in.), RH38 (1/2in.), RH34 (1/2in.), RH14 and 14/12 (1/2in.) RS6 (1/2in.).

SCREWING MACHINE

ATLAS No. 2, 3in.-6in. (Unused.)

SHAPERS

INVICTA 10in. and 14in.

NEWVEY 14in.

SHEET METAL MACHINES

FROST 6in. x 1/2in. Power Guillotine.

BESCO 21in. x 1 1/2in. Rolls.

RHODES 36in. Cramp Folder.

BESCO 48in. Treadle Guillotine.

SLOTTERS

EDGWICK.

TAPPERS

ESEX No. 24, 1/2in. cap.

ACE Horiz., 1/2in. cap.

J. & S. Electrotap, 1/2in.

THREAD MILLERS

WICKMAN MOULTON 1B.

SLOTING MACHINES

WILKINSON 10in. Cone Drive. £145.

J. E. RAISTRICK LIMITED,

RELIANCE WORKS,

FOYLE TRADING ESTATE,

COLNBROOK, SLOUGH, BUCKS.

Tel.: Colnbrook 2421.

One Secondhand Scrivener No. 1

Centreless Grinding Machine, maximum capacity 1 1/2in. diameter with Plunge Feed. Hand Operated. Motorised 400-440/3/50.

C. & G. OLDFIELD, Ltd.

15, Abercorn Street,

PAIRLEY.

HIGH QUALITY USED MACHINE TOOLS

Used PRECIMAX Type UPJ12/72 Hydraulic

Universal Cylindrical Grinding Machine

with variable speed workhead and elec-

trics to suit 400/3/50.

Used CINCINNATI No. 2 Tool and Cutter

Grinding Machine. 400/3/50.

HERBERT No. 12 Heavy Duty Combina-

tion Turret Lathe. Full chucking equip-

ment. 400/3/50.

TOWN 28in. Vertical Spindle Drilling

Machine. Compound table. 400/3/50.

E. & W. 33in. Sensitive Radial Drilling

Machine. Swing-aside table, swing-aside

arm. 400/3/50.

JONES & SHIPMAN 20in. Vertical Drilling

Machine. No. 4 Morse Taper. Power

feed. 400/3/50.

KEARNS No. 2 Standard Horizontal

Boring Machine with facing head and

sliding spindle. 400/3/50.

SNOW T20 Table Surface Grinding Machine.

ARCHDALE 28in. Horizontal Manu-

facture Milling Machine, with power and

rapid feeds. Table size 49in. x 30in.

400/3/50.

WE UNDERTAKE REBUILDING OF

ALL TYPES OF MACHINE TOOLS

CENTAUR TOOL WORKS,

EYRE STREET, SPRING HILL,

BIRMINGHAM, 12.

Tel.: EDGbaston

1118 & 1119

"Grange"

Capetan, Birmingham


Randalls
(LUTON) LIMITED


Selbourne Road
Luton Tel. 52351
New Machines From Stock

HARRISON 8in. Lathe.

VICTORIA U2 Miller.

INVICTA 4M Shaper.

RAGLAN 5in. Lathe.

PROGRESS 3E Pillar Drill.

CARDIFF 7 1/2in. by 40in. Lathe.

KEETONA 48in. Guillotine.

BEAVER Model 'A' Miller.

INVICTA Model 30 Shaper.

SELECTED USED MACHINES, INCLUDE:

EDGWICK 6in. Lathe with full

equipment.

HERBERT OV Swivel Head Vertical Mill.

FOOTBURY 5 M/T Pillar Drill.

WILLSON 7 1/2in. Newall Lathe.

When answering advertisements kindly mention MACHINERY.

ROLLS TOOLS LTD.

OF WOKING SURREY

AUTOMATICS

C.V.A.B Single Spindle.
B.M.W.13 13mm. S.S.
OOG BROWN & SHARPE S.S.
PITTLER 12mm. Swiss type.
AEB BECHLER 4 tools, 2 spindle attachment, slotting attachment.
AE4 BECHLER 1 spindle attachment.
2 GIBBS Swiss Type $\frac{3}{4}$ in. Capacity.

MULTI SPINDLE AUTOMATICS

$\frac{3}{4}$ in. B.S.A. ACME GRIDLEY RA6 spindle. Screwing spindle, Collets and Tooling. 3 available. 1944-1948.
1in. NEW BRITAIN GRIDLEY 6-spindle, Model 60. 3 available.
 $\frac{1}{2}$ in. CONOMATIC 8 spindle with screwing spindle, thread rolling, tooling and collets.
 $\frac{1}{2}$ in. CONOMATIC 4-spindle.

CUTTING OFF MACHINES

BALLINGER Abrasive type C.
CLIFTON & BAIRD Cold Saw. 6in.

LATHES

BINNS & BERRY A.G.H. 10in. centres & 6ft. between 36in. in gap. Speeds 22-490.
CHURCHILL-REDMAN A.G.H./SS & SC. 9in. centres by 6ft. between Gap Bed.
DEAN SMITH & GRACE A.G.H./SS & SC. 9in. centres by 4ft. 6in. between.
PRATT & WHITNEY A.G.H. 6 $\frac{1}{2}$ in. by 30in.
TRIDENT Gap Bed Lathe. 6 $\frac{1}{2}$ in. by 60in.
WARD HAGGAS & SMITH faceplate Lathe, 57in. swing, 64in. in gap. Short bed with adjustable gap.

GEAR HOBBING MACHINES

PFAUTER type R00.
MIKRON type 79.
CLEVELAND 130D.

MILLING MACHINES

CINCINNATI 08 Vertical.
THIEL Model 58-Tool Room Mill.
WADKIN High Speed Vertical, Table 35in. x 13in.

MILLERS THREAD

HILLE 6in. O/D Max.
MATTERSON No. 11.
HANSON WITNEY 9in. by 4in.
WICKMAN Moulton.
ARCHDALE with 120 Hobs.
WANDERER.

SHAPERS

ESSEX Punch Shaper Microscope and equipment.
ROCKFORD 28in. Hydraulic Universal.
INVICTA 6M 24in.
ALBA 4S 18in.

SLOTTERS

BUTLER RAPID 8in. Tool Room Machine.
BUTLER PRECISION 4in.

CAPSTAN AND TURRET LATHES

WARD No. 7 Capstans.
WARD No. 7 Combination. Serial K.
HERBERT No. 4 & 4 B.S.
HERBERT No. 2S & 1S and O.
HERBERT No. 13 Bar Turret.
GISHOLT No. 4 A.G.H. Capstan.
GISHOLT No. 3 A.G.H. Capstan (Collet).
GISHOLT No. 3 Simplified Capstan.
MODERN No. 1.
WARNER & SWASEY No. 1.
LIBBY 4R AGH Capstan.

RADIAL DRILLS

KITCHEN & WADE, 40in. Arm. Power Rise and Fall. Speeds 1,500 r.p.m., No. 3 Morse. Suds.
TOWN 5ft. Radial.
ARCHDALE Light Sensitive 36in. Rise and Fall Table. No. 3 Morse.

GRINDERS—SURFACE

SNOW VB.18, 72in. Traverse by 15in. wide.
SNOW P.24, 24in. by 8in. Hydraulic.
DOALL 20in. by 6in. Hydraulic Feed.
JONES & SHIPMAN Fig. 540. 6in. by 18in.
BLANCHARD 10C. 16in. Mag. Rotary Table.

BROACHING MACHINES

LAPOINTE Vertical 8 tons. 36in. Stroke.
LAPOINTE Horizontal 15 tons 50in. Stroke.
LAPOINTE Horizontal Twin Screw Stroke 40in.

DRILLS

HERBERT J TYPE. Single Column and two column machines.
ARCHDALE Snout Type Electrically Controlled Vertical Borer. 50 Int. Taper.
LELAND GIFFORD 2 Spindle No. 2 Morse Taper.
ASQUITH Horizontal Duplex M/c. No. 5 Morse, 5ft. dia. Rotary table.

PRESSES

TAYLOR & CHALLEN 40 ton Variable stroke—Guards.
85-ton RHODES Upright Geared.
16-ton RHODES Inclinable.
25-ton RHODES Inclinable.
35-ton RHODES Inclinable.
50-ton RHODES Inclinable.
60-ton TAYLOR & CHALLEN B.3 $\frac{1}{2}$. Variable stop up to 4in., with Roll Feed and Chopper.
BLISS No. 8 Power Press.
FLY PRESSES, Nos. 3, 4, 5, 6.
FLY PRESSES Horning, No. 4.

GRINDERS—UNIVERSAL

JONES & SHIPMAN. 10in. by 27in.
LANDIS 12in. by 36in.
HENRI KAESER Model L. 10 by 20.

LAPPING MACHINES

HAHN & KOLB 26in. dia. with Coolant Filter Plant.
PETER WOLTERS Hydraulic. Two Spindle Vertical Honing Machine.

GRINDERS—CYLINDRICAL

PRECIMAX HUP. 1, 7in. by 10in.
PRECIMAX HUP. 1 $\frac{1}{2}$, 7in. by 12in.
PRECIMAX MPO., 6in. by 24in. Plunge.
CARL UNGER 12in. by 36in.
NORTON 10in. by 24in.
KEIGHLEY K Model 6x18.

ANNUAL HOLIDAY

WILL YOU PLEASE
NOTE THAT OUR
WORKS WILL BE CLOSED
FROM 22nd JULY
UNTIL TUESDAY
8th AUGUST

All Electrics 400/3/50

ROLLS TOOLS LTD. No. 1 Factory, Pyrford Road, Pyrford, Woking
Contact Mr. P. W. Gander Telephone: Byfleet 43252/3 & 4145

Classified Advertisements (PLANT FOR SALE, contd.)

Harry Kirk Eng. Ltd.

can recommend the following modern
quality machines from STOCK

AUTOMATICS

WICKMAN 5in. Chucking Automatic.
RYDER Verticalauto, capacity 16in. swing
× 8in., 6 spindles.

BORING MACHINES

KEARNS O.B. Horizontal Boring Machine.
21in. Spindle. Spindle Speeds 15/600
r.p.m. Excellent condition.
RICHARDS 36in. Vertical Boring Mill,
complete with side head.
JONES 6in. Spindle Horizontal Borer.
Table 17ft. 6in. × 8ft. Spindle travel
48in. Rapid traverse 84in. per min.
Motorised 400/350. Weight 70 tons.
BULLARD 36in. Vertical Boring Mill.
KITCHEN & WADE Vertical Fine Boring
Machine, 14in. stroke. Compound table.

DRILLING MACHINE

ARCHDALE 8-Spindle Hydraulic Vertical
Drilling Machine.

GRINDING MACHINES

BROWN & SHARPE No. 2 Surface Grinder
18in. × 6in. table.
KELLER No. R6 Tool and Cutter Grinder.
LUMSDEN D.E. Tool Grinder.
HEAD No. 172 Gap Bed Internal Grinding
Machine, maximum diameter of component 36in.

LATHES

N.D. 8in. × 6ft. S.S. & S.C. Lathe. 30in.
between centres.
SMALLPIECE Lathe, type 6 WSLMS.
NOBLE & LUND Heavy Duty Centre Lathe.
22in. centre height × 29ft. between
centres. Max. swing over saddle 33in. dia.
HARVEY Heavy Duty Centre Lathe.
42in. centre height × 52ft. between
centres. Max. swing over saddle 65in. dia.

MILLING MACHINES

EDGWICK No. 2 Universal Milling Machine.
Working surface of table 38in. × 74in.
BROWN & SHARPE No. 3A Universal
Milling Machine with Vertical Head Attachment.
Spindle Speeds 30/1,200. Power
feed all movements.
COLLET & ENGLEHARDT Keller Type,
Die Sinking Machine. Model FK180,
capacity 60in. × 30in.

PLANING MACHINES

CLEVELAND Openside Planing Machine,
capacity 10ft. × 2ft. 6in.
CINCINNATI Planing Machine, capacity
8ft. × 2ft. 6in.

MISCELLANEOUS MACHINES

Hydraulic Vertical Internal Honing Machine
(manufactured by PETER WOLTERS),
Capacity 0.2in. to 2in.
RAPIDAN Double Helical Gear Generating
Machine, 12in. diameter capacity.

Further details from

**HARRY KIRK
ENGINEERING LTD.,**
BRANDON ROAD WORKS, BRANDON
ROAD, COVENTRY.

'Phone:
WALSgrave-ON-SOWE 2253 (6 lines).

G. A. ROBINSON (STOKE-ON-TRENT) LTD., HARTSHILL, STOKE-ON-TRENT, STAFFORDSHIRE

Tel. Newcastle (Staffs.) 04771 (5 lines).

COVENTRY BRANCH:

14/16, Queen Victoria Road,
Tel. Coventry 25418 and 26221.

USED AND RECONDITIONED MACHINE TOOLS AT BARGAIN PRICES

SCRIVEN H/D 8ft. × 1in. Plate Guillotine. Price £3,250
PALLAS Universal Miller, U2, 40in. × 10in.,
all geared, power traverse all round. Price £350
SAGAR (New) Wood Turning Lathes, full
equipment. (HALF NEW PRICE.) Price £200
CINCINNATI No. 4, Plain power feeds, dial
type, spindle speeds 18/1,300 r.p.m. Price £1,750
HERBERT 2-Spindle. All geared head on
3-spindle pedestal base, table 36in. × 15in.,
fitted No. 3 quick change chucks. Spindle
speeds 104-562. Price £200
RHODES Press Brake, 8ft. × 4in., Motor-
ised, undercranked. Price £750
RHODES Guillotine, 8ft. × 4in., motorised. Price £750
RHODES Press Brake, 4ft. × 4in., single
pulley drive. Price £250
RHODES Press Brake, 10ft. × 4in., under-
cranked, motorised. Price £500
RHODES Press Brake, 4ft. × 4in., single
pulley. Price £135
BESCO 75-ton D/Slided Inclinable, 44in.
stroke, motorised, fitted with Udal gears,
plates 27in. × 27in. Price £575
CINCINNATI No. 4 Vertical Miller, 1,300
r.p.m. Price £2,300
CINCINNATI 1/18 Manufacturing Miller,
1,500 r.p.m., with backlash eliminator. Price £675
MILWAUKEE No. 4 Horizontal, 1,000 r.p.m. Price £1,475
CINCINNATI Plain Grinder, 10in. × 36in.,
Model "ER" (As New), Late 1967. Price £1,550
REED PRENTICE Toolroom Lathe, 10in.
centres × 78in. between centres. Price £800
ARCHDALE 20in. Horizontal Miller, dial
type feeds and speeds, 615 r.p.m. Price £395
DEAN, SMITH & GRACE 61in. Centre
Lathes, taper turning, full equipment. Price £575 each
TOWN Radial Drilling and Tapping Machine,
6ft. arm rise and fall, tee slotted, low base,
No. 5 Morse taper. Price £675
RICHMOND 0.3 Plain Miller. Price £300
STANLEY 11in. Heavy Duty Lathe. Price £1,250
STANLEY 7in. Centre Lathe. Price £525
ARCHDALE Column Drill, compound table,
No. 5 Morse. Price £575
COVELL Hydraulic Surface Grinder, 24in.
× 6in. Price £775
2 off GLEASON Spiral Gear Roughing and
Finishing Gear Cutters, 12in. (excellent
condition). Price £250
SMART & BROWN Toolroom Lathe, 4in. ×
18in. b.c. Full equipment, collets and
attachment. Price £200
3 off—WARD No. 7 Capstan Lathes,
covered bed, power feeds turret, saddle
and cross slide, complete equipment,
four-way toolpost, rear toolpost, arranged
for chucking, 1,000 r.p.m., in excellent
condition. Price £350 each
MILWAUKEE "2H1" Vertical Miller,
swivel head, table 46in. × 9in., dial feeds
and speeds, 16 spindle speeds 35-1,088,
rapid traverse, pump, tank and fittings. Price £850
2 off—BROWN & SHARPE No. 13 Univer-
sal Tool and Cutter Grinders, complete
with equipment. Price £425 each
BRYANT No. 5 Internal Grinding Machine. Price £175

THESE MACHINES CAN BE INSPECTED
AT ANY NORMAL BUSINESS HOURS
AT OUR STOKE-ON-TRENT BRANCH

F. J. Edwards Ltd

PLANING MACHINES

BUTLER 8ft. Openside Planer with side head.
REDMAN 12ft. × 3ft. 6in. × 3ft. Planer, two
toolboxes.

SAWING MACHINES

MIDSAY 21in. Toolroom canting body Band-
sawing Machine.
TAYLOR No. 1142 high speed Circular Sawing
Machine, capacity bar 1in. dia., tubes 1 1/2in.
MIDSAY MINOR 16in. Toolroom Bandsawing
Machine. (New.)
SPEEDAX 16in. Bandsawing Machine for
metal, wood and plastics. (New.)

SCREWING MACHINES

KENDALL & GENT 6in. Screwing Machine, 3in.
bolts, 6in. tubes. Tangential die head with
leadcrew.
KENDALL & GENT 3in. tangential die head
Screwing Machine with leadcrew.
LANDIS 1 1/2in. Tangential Die-Head Screwing
Machine.
OSTER 6in. Screwing Machine, Cutting off
Attachment, large quantity of dies.

SHAPING AND SLOTTING MACHINES

BETTS 12in. stroke heavy duty Slotting
Machine.
SWIFT 20in. Slotting Machine.
INVICTA 6M Shaper, 24in. stroke.
ALBA 6S Shaping Machine, 24in. stroke.
BUTLER 12in. Shaper.
BROOK 24in. Shaping Machine, swivel table
and auto. hold down feed. (New.)
ORMEROD 26in. stroke Traversing Head
Shaper; two universal tables (1953).

TAPPING MACHINES

JONES & SHIPMAN "Electrotap" Vertical
Tapping Machine, leadcrew control with
auto cycle for depth, reverse and stop, 1 1/2in.
stroke, 200 r.p.m.
HERBERT 1/2in. No. 1 Flapstapper.

BORING MACHINES

WEBSTER & BENNETT 36in. Vertical Boring
Mill with Murray colour control, 6.5 to 124
r.p.m.
KEARNS OB Horizontal Borer, with screw-
cutting motion, covered bed spindle 21in.
GIDDINGS & LEWIS No. 0 Horizontal Boring,
Milling and Drilling Machine, 3 1/2in. traversing
spindle, table 45 1/2in. × 27 1/2in.

CAPTAN & TURRET LATHES & AUTOS
WARD No. 3A motor driven Capstan Lathes
with ball chuck and bar feed equipment.
WARNER & SWASEY 3A Turret Lathe; 4 1/2in.
hollow spindle, 23 1/2in. dia. swing over bed
covers.
HERBERT No. 7 Combination Turret Lathes;
hollow spindle 2 1/2in. dia., 16in. swing, speeds
18-366 r.p.m.
HERBERT No. 12 Combination Turret Lathe;
roller bearing spindle; covered vee bed,
swing over bed 23 1/2in.; hollow spindle 6 1/2in.
dial, good equipment; chasing saddle with
automatic sliding and surfacing feeds.
HERBERT No. 21 Combination Turret Lathe;
swing 28in. over the bed; 7 1/2in. hollow
spindle; chasing saddle with automatic
sliding and surfacing feeds.
HERBERT No. 4 Senior Capstan Lathe; 15 1/2in.
swing over bed, 40-1,000 r.p.m.
LIBBY 4A Capstan Lathe, 2 1/2in. hollow spindle,
20 1/2in. swing, speed 27-725.
WARD No. 7 Combination Turret Lathe,
14 1/2in. swing, 2 1/2in. hollow spindle, speeds
13-520 r.p.m. Chasing saddle, ball chuck.
No. 12 RYDERMATIC three slide Vertical
Multi-tool Lathe; maximum swing 20in.;
maximum length 16in.; vertical slide stroke
8in.; horizontal slide stroke 5 1/2in.

DRILLING MACHINES

TOWN 5ft. Radial Drilling Machine; spindle
No. 5 Morse taper; speed 26-580 r.p.m.
TOWN 8ft. Non-elevating Arm Radial Drill,
with box bed, 122-790 r.p.m. No. 5 Morse
Taper.
CINCINNATI HICKFORD 36in. Radial Drilling
Machine, spindle No. 4 M.T.
SEIG (Sweden) 27in. Radial Drilling Machine,
1 1/2in. capacity, speed 80-890 r.p.m. (New.)

359-361, EUSTON RD., LONDON, N.W.1
Telephone: EUSTON 5000 Telex No. 24264
And at Lansdowne House, 41, Water St.,
Birmingham, 3. Telephone: Central 7606-8

When answering advertisements kindly mention MACHINERY.

Classified Advertisements (PLANT FOR SALE, contd.)

RING BELLS for machine tools

LEEDS 63-7398

LELAND-GIFFORD 4 spindle Drill. T-slotted table 72in. by 22 $\frac{1}{2}$ in. All spindles bored No. 3 M.T. with 8 $\frac{1}{2}$ in. traverse. 16 $\frac{1}{2}$ in. between spindle centres. 1 spindle with power feed. Centre to back 12in. 8 speeds 165-1,500 r.p.m. M.D. 220/3/50 with transformer for 400/3/50.

CHURCHILL No. 1 Planetary Grinders. Cap. with largest spindle 10in. dia. by 18in. long. M.D. 400/3/50.

JONES & SHIPMAN Fig. 138 Universal Precision Grinder. Cap. 27in. by 10in. Swivelling and elevating wheelhead. With internal spindle, etc. M.D. 400/3/50.

CARTER & WRIGHT No. 4 Dual Feed Keyseater. T-slotted table 38in. by 12in. Cuts keyways up to 30in. by 1 $\frac{1}{2}$ in. M.D. 400/3/50.

HERBERT 2B Capstan. Swing over flat bed 11in.; over cross-slide 5in. A.G.H. 6 speeds 97-2,034 r.p.m. Spindle bore 1 $\frac{1}{2}$ in. Duo-feed to cross-slide. With bar feed and stands, electric suds pump and about 30 collets. M.D. 400/3/50.

WILLSON 7 $\frac{1}{2}$ in. Gap-Bed S.S. & S.C. Lathes. Admits 36in. between centres and 26in. in gap. 9 speeds 26-477 r.p.m. M.D. 400/3/50.

BROWN & SHARPE No. 2 Light Type Plain Miller. Table 45in. by 10in. Power all ways. Speeds 14-1,300 r.p.m. M.D. 400/3/50.

LANG 20in. Boring and Facing Lathes. Swing over flat bed 23in.; over bed covers 21in. A.G.H. 12 speeds 12-600 r.p.m. Hexagon turret on swivel compound slide. Max. spindle nose to turret face 27in. M.D. 400/3/50.

CINCINNATI 3/36 Hydromatic Miller. Speeds 8-200 r.p.m. Table size 52 $\frac{1}{2}$ in. by 14in. Single cycle.

ARCHDALE 30in. Vertical Miller with Power Operated Rotary Table. Table 47in. by 14 $\frac{1}{2}$ in. Long. traverse 34in. M.D. 400/3/50.

MILWAUKEE 2K Vertical Miller. Table 56in. by 12in. With power all ways including head. 24 speeds 15-1,500 r.p.m. M.D. 400/3/50.

BLISS No. 18C Inclinable Power Press. Cap. 8 tons. Fixed stroke. Bed to ram guides 8 $\frac{1}{2}$ in. Bed size 15in. by 11in. with 9in. by 5in. hole. Hole in ram 1 $\frac{1}{2}$ in. Bolster fitted with 8 station indexing attachment. M.D. 400/3/50.

SWEENEY & BLOCKSIDE No. 7 Power Press. Inclinable, ungear, open fronted. Tonnage rating 10. Fixed stroke 11in. M.D. 400/3/50.

TAYLOR & CHALLEN Model 266 Double Sided Power Press. 40 tons cap. Single action, non-inclinable. Fixed stroke 1 $\frac{1}{2}$ in. Bed area 18in. by 16 $\frac{1}{2}$ in. Bed to ram guides 15in. Machine fitted with strip feed to take 4 $\frac{1}{2}$ in. strip and also scrap-shear. M.D. 400/3/50.

OLDFIELD & SCHOFIELD Model 00 Straightening Press. Tonnage 4. Ram stroke 3in., pedal control. 4 H.P. motor 400/3/50.

ORMEROD Bin. Production Slotter. 4 ram speeds 23-71 r.p.m. 18in. dia. circular table. Ram face to back of throat 15 $\frac{1}{2}$ in. F. & R. to all traverses. M.D. 400/3/50.

H. BELL (Machine Tools) LTD., Walter Street, LEEDS 4.

Warner & Swasey No. 1A Combination Turret Lathe, Serial No. 434730.

Further details from
C. & G. OLDFIELD, LTD.,
15, Abercorn Street,
PAISLEY.
Member of B.A.M.T.M.

HIGH QUALITY USED MACHINE TOOLS

ARCHDALE 20in. Milling Machine, table size 40in. x 10in., power and rapid traverses to table, reversing spindle, backlash eliminator. 400/3/50.

COVMAO 13in. Swing Gap Bed Lathe, by 6ft. 5in. b.c. 400/3/50.

DUNHAM 6in. Gap Bed Lathe by 2ft. 3in. b.c. 400/3/50.

BARONIS & OLIVER No. 3 Universal Turret Lathe. 400/3/50.

WARNER & SWASEY 1A Turret Lathe. 400/3/50.

KELLY 28in. Stroke Heavy Duty Shaping Machine with swivelling table. 400/3/50.

RUSSELL Saw Sharpening Machine, max. capacity 42in. diameter. 400/3/50.

ORMEROD 12in. Slotting Machine. 400/3/50.

WE UNDERTAKE REBUILDING OF ALL TYPES OF MACHINE TOOLS

CENTAUR TOOL WORKS,
EYRE STREET, SPRING HILL,
BIRMINGHAM, 18

Tel. EDGaston 1118 & 1119. Capstan, Birmingham.

DRILLING MACHINES

STOREY "25" Pillar. £175.

TOWN 4ft. Radial, Low Base, Loose Box, S.P.D. £275.

ARCHDALE Heavy Duty, 36in., Pillar. £375.

J. E. RAISTRICK LIMITED,
RELIANCE WORKS,
POYLE TRADING ESTATE,
COLNBROOK, SLOUGH, BUCKS.

Tel. Colnbrook 2421.



No. 3 **GISHOLT** Bar Feed Capstan Lathe with equipment.

No. 2 **WARNER & SWASEY** Capstan Lathe. Chucking.

2D **HERBERT** Bar Feed Capstan.

No. 3 **GISHOLT** Chucking Capstan.

43in. x 12in. **FITZ WERNER** Vertical Miller. Swivelling head.

U3 **VICTORIA** Universal Milling Machine with Vertical and Slotting attachments. 8 years old.

20in. **ARCHDALE** Plain Miller. Power feeds and rapids. Spindle speeds 60-1,230 r.p.m.

20in. **ARCHDALE** Plain Miller. Power feeds and rapids. Spindle speeds 30-615 r.p.m.

No. 3 **KITCHEN & WADE** Honer.

No. 2 **KITCHEN & WADE** Honer.

11in./16in. **NOBLE & LUND** Hydraulic Cold saw with Hydraulic clamp.

Model **HBV CHURCHILL** Electrical Grinder.

14in. **BUTLER** Slotter. Power revolving table.

8in. **FABIUS** S.S. & S.C. Lathe. 5ft. between centres. As new.

No. 3 **RICHARDS** Horizontal Borer Model PRT3.

No. 3 **KEARNS** Horizontal Borer.

No. 2 **KEARNS** Horizontal Borer.

8in. **REED PRENTICE** Lathe 6ft. 6in. between centres.

16in. **CRAVEN** Lathe 20ft. between centres.

54in. x 15in. **CRAVEN** Universal Milling Machine.

HERBERT S.E. Capstan Lathe.

24in. **ORCUTT** Automatic Gear Grinder (New).

4A **LIBBY** Turret Lathe.

CRAVEN Worm Milling Machine.

DIMCO (Gt. Britain) LTD.

28, Wood Lane,

SHEPHERDS BUSH,

LONDON, W.12.

SHEPHERDS Bush 4401/2.

Reed Prentice No. 5 Vertical Milling Machine. Table 63in. x 16in. 18 Spindle Speeds 17-600 r.p.m. Excellent condition. Further details from—

C. & G. OLDFIELD, LTD.,
15, Abercorn Street,
PAISLEY.

"Pels" Type GEF. 30 m/d. steel-frame d/ended angle and Tee Cropping M/c. Cap. 6in. x 6in. x 1in. angles, 3 $\frac{1}{2}$ in. x 3 $\frac{1}{2}$ in. x 1in. at 60 deg. 6in. x 6in. x 1in. tees. 5in. x 5in. x 1in. at 45 deg. 4in. x 3in. x 1in. at 45 deg. Flats up to 6in. x 1in. Drive by 7 $\frac{1}{2}$ h.p. 400/3/50 motor.—LEE & HUNT, LTD., Crocus Street, Nottingham. Phone: 84246.



Crank Pin Turning Machine
Mr. RICHARDS—Single Head Type with rotating cutter head and stationary crank shaft.

Main dimensions :—
Slide travel 12in.
Dia. revolves disc 24in.
Work table 4 ft. 10in. by 3ft. 6in.
Main motor 35 H.P.
Feed motor 6 $\frac{1}{2}$ H.P.
Inspection invited.

Full details from :—
SOAG MACHINE TOOLS LTD.,
7, Juxon Street, Lambeth,
London, S.E.11

Corona Heavy Duty Vertical Drilling machine. No. 3 Morse Taper. Excellent condition.

Further details from —
C. & G. OLDFIELD, LTD.,
15, Abernethy Street,
PAISLEY.

Bechler 16 mm. Sliding Head automatic, 3-way attachment, 4-slide, 400/3/50 electric, gears, barfeed, etc. Ex. cond. also Peterman 10-HS 3-way and diehead atts. 5-slide 400/3/50, modern, ex. cond.—C. L. THOMAS, LTD., Stirling Road, Solihull. Tel. 3075-6.

When answering advertisements kindly mention MACHINERY.

Classified Advertisements (PLANT FOR SALE, contd.)

Newman**AUTOMATICS**

BULLARD Multi-Au-Matic 7in. 8 spindle.
BULLARD Multi-Au-Matic 12in. 6 spindle.

BORING MACHINES

UNION Model BFT 100 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle (1955).

KEARNS Model OC Horizontal Boring Machine, 3in. dia. travelling spindle.

KEARNS No. 4 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle.

WEBSTER & BENNETT Vertical Boring Machine, table 60in. diameter.

RICHARDS Type PRT Horizontal Floor Boring Machine, 5 1/2in. travelling spindle, 28in. diameter facing head.

GIDDINGS & LEWIS No. 45 Horizontal Boring Machine, 5in. diameter travelling spindle.

CAPSTAN AND CENTRE LATHES

CHURCHILL-REDMAN Model 13NM Heavy-Duty S.S. & S.C. Gap Bed Centre Lathe, 13in. centre height x 72in. between centres.

Swing in gap 50 in.

MITCHELL Model DM10 S.S. & S.C. Gap Bed Centre Lathe, 10 1/2in. centre height x 7 1/2in. between centres. (NEW).

OLDFIELD & SOHOFIELD Surfacing and Boring Lathe, 10 1/2in. centre height.

WARD 7B Combination Turret Lathe.

MILES Heavy Duty Centre Lathe, S.S. & S.C. 17in. centre height x 28ft. between centres.

U.L.E.O. Heavy Duty Centre Lathe, 16in. centre height x 50ft. between centres.

DRILLING MACHINES

REITNER Radial Drilling Machine, 10ft. elevating arm.

GEAR MACHINES

ORCUTT Model HM24 Hydraulic Internal Gear Grinder.

GLEASON 3in. Straight Bevel Gear Generator.

GRINDING MACHINES

GRAVEN Roll Grinding Machine, capacity 20in. swing x 138in. between centres.

CHURCHILL Model HBY Internal Grinding Machine.

CHURCHILL Plain Cylindrical Grinding Machine, 26in. swing x 84in. between centres (1951).

LANDIS Type C Plain Hydraulic Cylindrical Grinding Machine, 6in. swing x 18in. between centres.

ORCUTT Model HM24 Internal Spur Gear Grinding Machine.

CHURCHILL Plain Hydraulic Cylindrical Grinding Machine, 20in. swing x 72in. between centres.

BROWN & SHARPE Plain Cylindrical Grinding Machine, 10in. swing x 36in. between centres.

MILLING MACHINES

CINCINNATI No. 3 High Speed Dial Type Vertical Milling Machine (1950).

CINCINNATI Model 5/72 Plain Hydromatic Milling Machine, table 91in. x 22in. (1952).

CINCINNATI No. 2L Plain Horizontal Milling Machine, table 52in. x 10in.

CINCINNATI No. 1M Vertical Milling Machine.

CINCINNATI No. 4 Dial Type Horizontal Milling Machine.

FRATT & WHITNEY Model RL3620 3-spindle "Keller" Die Sinking Machine.

CENTEO Model 3R Automatic Production Milling Machine, table 25in. x 16in.

PLANING MACHINES

CANTONI Double Column Planing Machine, capacity 120in. x 48in. x 48in., two tool-boxes on cross side. (1952.)

MISCELLANEOUS

LANG & GAILLARD 28in. stroke Double Headed Hydraulic Shaping Machine.

TAYLOR & CHALLENGE Double Sided 50-ton Geared Power Press, 10in. stroke.

NEWMAN INDUSTRIES LIMITED

Machine Tool Division: **YATE, BRISTOL**

Tel.: Chipping Sodbury 3311. Telex. 44121.

Cables: "Dynamo Yate."

London Office: Terminal House, Grosvenor Gardens, S.W.1. Tel: Sloane 8206.

Telex. 23229.

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**SCHIESS DEFRIES** Horizontal Boring Machine,  
table type, Model HB13, with travelling  
spindle and facing slide with automatic feed.  
Spindle diameter 5 1/2 in. Spindle travel 4 1/2 in.  
to 27 1/2 in.; working surface of table 63in. x  
55in.; cross movement of table 63in.; maxi-  
mum distance spindle to stay 11ft. 6in.; 12  
spindle speeds from 3 to 175 r.p.m.; h.p.  
motor 15.

**KEARNS** No. 5 "Patent" type, with travelling  
spindle 5in. diameter, continuous automatic  
facing head, facing capacity 55in.; table  
(main) 80in. x 48in.; top table 60in. x 60in.;  
maximum distance spindle nose to outer  
stay 14ft.; spindle speeds 2.3-208 r.p.m.;  
h.p. motor 20. Extra long.

**KEARNS** No. 4 "Patent" type, with overize  
spindle 4 1/2 in. dia., continuous automatic  
facing head, covered bedways, table (main)  
66in. x 42in.; maximum distance spindle nose  
to outer stay 93in.; h.p. motor 15.

**NILES** W8 with travelling spindle 3 1/2 in. (80 mm.);  
continuous automatic facing head, facing  
capacity 37 1/2 in., table 43 1/2 in. x 36in.; maxi-  
mum distance facing head to outer stay 90in.;  
16 spindle speeds from 5.75 to 500 r.p.m.;  
2-speed flanged motor drive 6.5/10 h.p.

**KEARNS** No. 2 "Patent" Type, with travelling  
spindle, 3in. diameter, continuous automatic  
facing head, facing capacity 30in.; covered  
bedways; table (main) 45in. x 30in.; maxi-  
mum distance facing head to outer stay 66in.;  
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10.

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MOREY 2G 1in. cap. with collet head and bar feed.

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WARD No. 16, covered bed, 8 $\frac{1}{2}$ in. spindle, 32in. 4-jaw chuck, rapid and power feeds to saddle, cross slide and turret, power rotating turret, spindle speeds 7-225 r.p.m., 50 h.p. motor.

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SUNSTRAND No. 2 Electro Mill, auto. cycle, 12in. by 5 $\frac{1}{2}$ in. table.

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| 12in. by $\frac{1}{2}$ in.          | G     | £21. 0.0  |
| 16in. by 1in.                       | G     | £23. 0.0  |
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| 31in. by 2in. by 18G                | G G   | £22. 0.0  |
| 37in. by 2in. by 18G                | G G   | £27.10.0  |
| 42in. by 2 $\frac{1}{2}$ in. by 18G | G G   | £37.10.0  |
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| 72in. by 3in. by 16G                | G     | £82. 5.0  |
| 36in. by 3in. by 14G                | F     | £90. 0.0  |
| 48in. by 3in. by 14G                | F     | £95. 5.0  |
| 72in. by 3in. by 14G                | F     | £145. 0.0 |
| 36in. by 4in. by 4G                 | G     | £155. 0.0 |
| 48in. by 4in. by 4G                 | G     | £162.10.0 |
| 72in. by 5in. by 4G                 | G     | £245. 0.0 |

## POWER BENDING ROLLS

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| 48in. by $\frac{1}{2}$ in. | F     | £300. 0.0 |
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| 72in. by $\frac{1}{2}$ in. | F     | £795. 0.0 |
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| 72in. by $\frac{1}{2}$ in. | F     | £895. 0.0 |

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Double Ended Angle Cropping Machine, Cap. up to 6in. x  $\frac{1}{2}$ in. angles.

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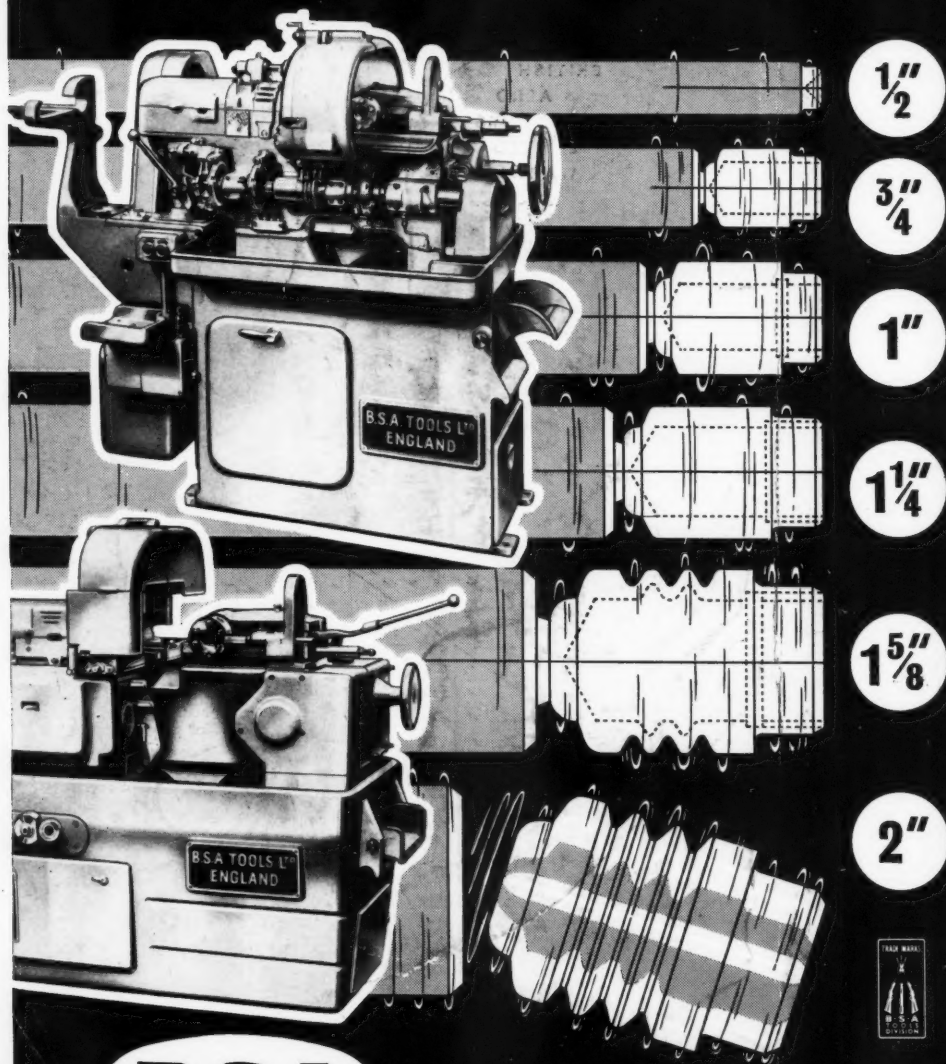




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